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A New Subspecies of *Pseudemys floridana*, with Notes on the *floridana* Complex

By A. F. Carr, Jr.

SEVERAL points in Le Conte's *Description of the Species of North American Tortoises* (1836) I find difficult to reconcile with his evident astuteness as an observer. Among these apparent lapses, his failure to assign a member of the *P. floridana* group to the Atlantic coastal plain is perhaps the most singular. His remarks on the range of *concinna* definitely restrict it to the Piedmont,[1] while of *floridana* he says, "Inhabits in St. Johns river of East Florida." If Le Conte had taken all his data from museum specimens the gap which he left in the range of the group might be attributable to lack of material. But it is evident that his field acquaintanceship with turtles was extensive. Moreover, the neglected region includes the section of southern Georgia (Riceboro, Liberty County) in which the Le Conte plantation was located.[2] Although I have not been in Liberty County since the days when all turtles were "cooters" to me I recall distinctly that a big brown *Pseudemys* used to be common in the vicinity of Riceboro.

The high-shelled *Pseudemys*, with the upper jaw relatively smooth and entire, inhabiting the coastal plain from northern Florida to North Carolina, has been referred to *floridana*, to *concinna*, or to both by various authors. Brimley (1907), for example, records both from North Carolina. I have seen his specimens, and am convinced that they are phases of a single form, which is a fairly homogeneous coastal plain stock intergrading with *concinna* along the fall line and with a peninsular race in northern Florida.

Since the St. Johns River rises in the range of the peninsular form and invades that of the coastal plain population, and since Le Conte's specimens probably were collected in the lower (northern) reaches of the river, the type might have been a specimen of either race or an intergrade. As I have mentioned previously (1935), the description of *floridana* gives little indication as to which race Le Conte had. However, the failure to mention a fairly conspicuous diagnostic character of the peninsular race—the confluence behind the eye of the supra-temporal and para-median head stripes—may be regarded as slight evidence that the description was based on the more northern form. I propose, therefore, to restrict the name *floridana* to the coastal plain population, and to describe the peninsular terrapin as a new subspecies.

Pseudemys floridana ***peninsularis,*** n. subsp.

Type.—Museum of Comparative Zoology 43849, adult female. Collected at Crystal Springs, Pasco County, Florida, Feb. 20, 1938, by Lewis Marchand.

Diagnosis.—Differs from *f. floridana*, its nearest ally, as follows: supra-temporal and para-median head stripes confluent behind the eye (or at least

[1] "Inhabits in the rivers of Georgia and Carolina, where the beds are rocky. I have never seen them below Augusta on the Savannah, or Columbia on the Congaree."

[2] The Riceboro plantation was established in 1810 by Louis Le Conte, brother of John, who was a New Yorker. Louis and his sons were all ardent naturalists, and although I can find no record of John's having visited his brother prior to the publication of his paper, it seems unreasonable to suppose that correspondence regarding the local fauna had not been exchanged.

continuing anteriorly as one line) in *peninsularis,* remaining separated and continuous to snout in *floridana;* a post-orbital stripe, extending from posterior margin of orbit to anterior border of tympanum, usually lacking in *peninsularis,* usually present in *floridana;* cervical portion of supra-temporal stripe usually much broader than para-median in *floridana,* the two usually more nearly equal in width in *peninsularis;* blotches on lower marginal sutures solid in *peninsularis,* with light centers in *floridana;* ground color of plastron very light, greenish white, or very dilute yellow.

DESCRIPTION.—Highest point of carapace usually anterior to middle of its long axis; one or more of the posterior vertebrals slightly keeled; jaws smooth or slightly serrate.

Ground color of carapace black or very dark brown; pattern usually much reduced, but otherwise not essentially different from that of the other races of *floridana;* middle intermarginal sutures bisecting dark blotches, which become obsolescent anteriorly and are often lacking on the posterior sutures; bridge immaculate, or with one or two blotches like those on marginals; plastron unmarked; ground color of head and limbs lustrous sooty black; stripes on soft parts light green, greenish yellow, or greenish white; anterior surface of fore limb with one to four stripes; three (rarely five) stripes on top of head between supra-temporals, at a point above tympana.

Proportionate measurements as follows: length/height males 2.27–2.43, av. 2.38, females 2.14–2.39, av. 2.22; length/width males 1.33–1.88, av. 1.49, females 1.26–1.51, av. 1.39; length/height of bridge at marginal suture six males 5.09–5.93, av. 5.55, females 3.93–7.00, av. 5.22; width/width at marginal suture six, males 1.04–1.14, av. 1.08, females 1.00–1.10, av. 1.03.

PARATYPES.—MCZ [3] 43850 (allotype), same data as type; MCZ 44069, near Woodmere, Sarasota Co., Fla., Nov. 18, 1936, A. Carr; MZUM 83358, Marion Co., Fla., near Umatilla, Nov. 3, 1933, A. and T. Carr; MZUM 83359, Charlotte-DeSoto Co. line, Nov. 15, 1936, Stewart Springer; USNM 104389, Crystal Springs, Pasco Co., Fla., Feb. 20, 1938, L. Marchand; USNM 104390, near Umatilla, Lake Co., Fla., March 16, 1934, A. Carr; CM 9875, 9876, and 9877, Crystal Springs, Pasco Co., Fla., Feb. 20, 1938, L. Marchand; Dept. Biol. Univ. Fla. 951, Dade Co., Fla., March, 1937, T. Barbour; same, 927, Manatee Co., Fla., Jan. 18, 1937, A. Carr; same, 1685, Crystal Springs, Pasco Co., Fla., Feb. 20, 1938, L. Marchand.

REMARKS.—The turtles of the genus *Pseudemys,* and particularly those of the *floridana* series, are a notoriously confusing group. Although I have studied them during the last three years, there remain problems which I believe will find solution only in long-time breeding experiments. However, several points which seem to me helpful in understanding relationships within the complex have become evident. These are as follows:

1. Due to inherent genetic instability, or to re-establishment of intercourse between previously isolated stocks, individual variation within a local population (even in a single litter) may result in phenotypes superficially more dissimilar than the actual races. Nevertheless, there are recognizable races, and although their racial characters often appear trivial in comparison with the gamut of individual variation, they are fairly constant and are

[3] MCZ = Museum of Comparative Zoology; MZUM = Museum of Zoology, University of Michigan; USNM = United States National Museum; CM = Carnegie Museum.

correlated with geographic provinces.

2. The characters stressed in many existing descriptions are those subject to the above-mentioned individual variation or are involved in sexual dimorphism. Original descriptions are thus largely inadequate.

3. The *floridana* complex constitutes a *Rassenkreis* which extends westward in two limbs from the Atlantic coastal *floridana*—an inland series (*concinna, hieroglyphica, texana*), and another in the coastal plain (*peninsularis, suwanniensis, mobiliensis*).

4. Intergradation has been observed between the following: *floridana* x *peninsularis, peninsularis* x *suwanniensis, suwanniensis* x *mobiliensis, floridana* x *mobiliensis, floridana* x *concinna, concinna* x *hieroglyphica, concinna* x *suwanniensis* x *mobiliensis, hieroglyphica* x *mobiliensis, hieroglyphica* x *texana*. I have seen no specimens from the Gulf coast of Texas, where *mobiliensis* x *texana* intergrades should occur.

5. Although many of the racial characters behave as if they were linked, these same characters occasionally show an apparent crossing over, so that in a given area of intergradation there may be found typical phenotypes of both intergrading races, and series showing both concurrent and independent intergradation of the several characters involved. Moreover, an occasional fortuitous combining, in an individual of one race, of all the characters peculiar to another, may be observed—even in a section of the range well removed from the intergrading area. The interpretation of the occurrence of such examples as overlapping of ranges has, no doubt, been a salient source of confusion.

6. The characters stressed as diagnostic by Holbrook (1842) in his description of *hieroglyphica* are all equally applicable to *concinna*. The type of *hieroglyphica*, taken in the Cumberland River, Tennessee, seems to me to be intermediate between Piedmont *concinna* and a recognizable trans-Mississippi race which is fairly homogeneous throughout Arkansas and eastern Texas. Although contrary to expectations based on physiography, the population between the Appalachians and the Mississippi River does not appear distinguishable racially, but seems rather to comprise a gradient connecting *concinna* with the Arkansas form. Since the type of *hieroglyphica* is slightly closer, both morphologically and geographically, to the Arkansas race than to Piedmont *concinna*, and since the name *texana* must be reserved for what appears to be a strikingly different Texan race, the Arkansas form may logically be referred to *hieroglyphica*.

Key to the Races of *P. floridana*

The following key presents an outline of my concept of the *floridana* group. Insofar as it defines, after a fashion, and applies the appropriate available names to the seven different populations recognized, it may be of value. However, several of these populations (and perhaps all of them) must be regarded as hierarchal assemblages of lesser colonies which are isolated to varying degrees, and which together constitute a nodal gradient, the nodes corresponding to the series of lakes, ponds, streams, and stream systems occupied. The marked genetic instability mentioned above, and the disinclination of turtles of this group to wander far overland, have in Florida at least, resulted in an astonishing number of these feebly differentiated colonies.

Despite considerable recent exhortation regarding the proper attitude of the taxonomist toward sub-racial categories of this sort, no widely accepted plan has been proposed. The use of a graded series of polynomials would probably merely introduce inconsistency and confusion, while the designating of each sub-racial colony with the trinomial would serve only to vitiate the significance of the subspecies as a zoogeographic category. Until more material has accumulated, and until it can be determined whether, and to what extent, the local variations are due to ecological rather than to genetic factors, I think taxonomic recognition should be withheld. Thus, Brimley's *P. elonae* (1928) and *P. vioscana* are here regarded as synonyms of *concinna* and *mobiliensis* respectively; *hieroglyphica* is extended to include *P. labyrinthica* (LeSueur); and several distinguishable forms of *peninsularis, suwanniensis,* and *floridana* are not given names.

1. Upper jaw with a distinct notch bounded by rounded or sharp cusps; lower jaw with a cusp-like prominence on either side of, and nearly equal in length to, a strong cusp at the symphysis; tubercles on masticating surfaces of alveolar ridges very long; lines on sides of head very numerous, some of them broken to form short bars and spots; a vertical extension of orbito-mandibular stripe often extending through tympanum; outline of carapace elliptical from dorsal aspect.....*texana*
(Southern Texas and northeastern Mexico. Type, ANSP[4] 246; San Antonio, Texas.[5])
Upper jaw entire or emarginate, without cusps; lower jaw toothed at symphysis, but usually without strong auxiliary cusps; alveolar tubercles in upper jaw not extending below cutting edge; lines on sides of head usually unbroken; usually no vertical bar through tympanum 2
2. Upper jaw usually with a slight to strong median emargination; lines on top of head numerous, many of them discontinuous and connected by one to many straight or crescentic transverse bars behind sagittal line; many of the lines (usually 8 or more) on dorsal surface of neck between supra-temporal stripes sub-equal in breadth; plastron very light—often almost white—and usually with a more or less complete dusky, dendritic pattern; carapace low, flattened, short, and oblong—very strikingly so in the female ..... *hieroglyphica*
(Central Tennessee, southern Indiana, and southern Illinois to Oklahoma and central Texas. Type, ANSP 217; Cumberland River, Tennessee.)
Upper jaw not emarginate; lines on top of head mostly continuous—not broken, irregular, nor connected by adventitious branches; lines between supra-temporals (at a point above tympana) not subequal in breadth, one pair usually being much the most conspicuous, another pair (and often a single median line) less so, and a variable number of others obsolescent in adults or lacking in old specimens; ground color of plastron deeper yellow to reddish orange, or if very light, then plastral markings always absent; plastral pattern present or absent; carapace never strikingly short, oblong *and* low 3
3. Plastral markings absent.....4
Plastron with a rudimentary to extensive dusky figure.....5
4. Supra-temporal and para-median head stripes confluent (or nearly so) behind eye, continuing along top of head to snout as one line; lower marginals with solid, smudge-like blotches; plastron (in life) greenish-white or light greenish-yellow.....*peninsularis*
(Peninsular Florida, from southern Marion County to Key Largo. Type, MCZ 43849; Crystal Springs, Pasco County, Florida.)
Supra-temporal and para-median head stripes separately continuous along top of head; blotches on lower marginals enclosing light areas; plastron (in life) yellow or orange-yellow .....*floridana*
(Coastal plain from North Carolina to Alabama and northern Florida. Type apparently not in existence.)

[4] ANSP = Academy of Natural Sciences of Philadelphia.
[5] One paratype of *texana* (USNM 7173), from Old Fort Cobb, Oklahoma, is fairly typical *hieroglyphica*.

5. Length/height ratio, males 3.06–3.46, av. 3.26, females 2.62–3.11, av. 2.87; upper jaw not (or barely) serrate; ground color of soft parts light to dark brown; stripes on head and limbs yellow or orange, occasionally reddish; ground color of carapace brown, light markings usually extensive and conspicuous.....*concinna*
(Maryland to eastern Tennessee and northern Alabama in the Piedmont. Type apparently not in existence.)
Length/height ratio, males 1.71–3.16, females 2.28–2.73, av. 2.63; ground color of head, limbs, and carapace black and upper jaw serrate, often strongly so; if upper jaw is not serrate then markings of carapace reduced, the ground color greatly predominating 6
6. Ground color of carapace, limbs, and head light to dark brown, stripes and reticulations yellow, orange-yellow, or reddish; four or more lines on outer surface of fore limb; outer surface of hind limb striped; usually seven or more lines between eyes .....*mobiliensis*[6]
(Gulf Coast from extreme western Florida to eastern Texas. Type, ANSP 242; Mobile, Alabama.)
Ground color of carapace, limbs, and head lustrous, sooty black, stripes and reticulations light greenish-yellow; two or three lines on outer surface of fore limb; outer surface of hind limb not striped; five lines between the eyes.....*suwanniensis*
(Rivers of the Gulf drainage and coastal waters in Florida from Citrus and Sumter counties to Appalachicola. Type, MZUM 81673; Suwannee River at Manatee Springs, Dixie-Levy county line.)

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[6] It seems likely that the cusp-jawed *P. alabamensis* Baur may eventually be shown to be a mutant occurring in *mobiliensis* and *suwanniensis* (Carr, 1938). In the event that this is established, emphasis must be placed on head-striping in distinguishing between *mobiliensis* and *texana*.

A Review of the Snake Genus *Farancia*[1]

By Hobart M. Smith

SEVERAL years ago Dr. Frank N. Blanchard observed that certain color differences exist between eastern and western specimens of *Farancia abacura*, but because of other research projects which then occupied his attention, he was unable to study the *Farancia* problem in detail. He did, however discuss it with his colleague and former student, Dr. Howard K. Gloyd. After Dr. Blanchard's death, this was one of the unfinished problems turned over to Dr. Gloyd, at whose suggestion I have undertaken a study of the variation occurring in the genus.

A study of 219 specimens has led to the conclusion that two readily definable subspecies exist in *F. abacura*. Most of these specimens have been examined by myself; part were examined by Dr. Blanchard and Dr. Gloyd, and the data secured by them have been used wherever possible. I wish to thank the owners or authorities [2] in charge of these specimens for numerous courtesies facilitating this study which were extended to Dr. Blanchard, Dr. Gloyd and to me, and in particular to express my gratitude for invaluable assistance kindly afforded by Dr. Gloyd, Walter Necker, Karl P. Schmidt, and Dr. Leonhard Stejneger.

Farancia Gray [3]

Diagnosis.—Scales smooth (except above anus), without apical pits, in 19 rows throughout (rarely 20 or 21 near neck, 18 near anus); maxillary teeth subequal, 17 or 18; mandibular teeth subequal; vertebral hypapophyses present anteriorly, absent posteriorly; sulcus spermaticus forked near middle; hemipenis slightly bifurcate, with about 18 large spines and numerous other smaller spines, calyculate distally; one internasal; no preocular; subcaudals divided.

Systematic Status and History.—The genus *Farancia* was described in 1842 by Gray (Zool. Misc.: 68), who included a single species, *drummondii*, genotype by monotypy and a synonym of *abacura*. The genus *Callopisma* was described eleven years later by Duméril (Mem. Acad. Sci. Paris, 23, 1853: 454, part) who included in it the species *erythrogramma, abacura* and *plicatilis*. These species are now placed in monotypic genera (*Abastor, Farancia* and *Dimades*, respectively), all of which were described before *Callopisma*.

The similarities of *Farancia* and *Abastor* have suggested the possibility that the two species (*abacura* and *erythrogrammus* respectively) concerned might be congeneric. The suggestion seemed still more plausible when two specimens of *F. abacura* were found with the internasal half divided. How-

[1] Contribution from the Chicago Academy of Sciences.

[2] These are: American Museum, Alabama Museum of Natural History, Baylor University, California Academy of Sciences, Chicago Academy of Sciences, Cornell University, Carnegie Museum, Clemson College, Charleston Museum, Field Museum, Kansas University, Museum of Comparative Zoology, Museum of Vertebrate Zoology, University of Oklahoma, Ottawa University, Academy of Natural Sciences of Philadelphia, San Diego Society of Natural History, Toledo Zoological Society, University of Louisiana, University of Texas, Museum of Zoology University of Michigan, U. S. National Museum, and Laura Brodie, F. N. Blanchard, P. D. Evans, C. C. Goff, Heinze-Boyer, Roy L. Montgomery, Jim Mitchell, M. V. Parker, H. K. Gloyd, Percy Viosca, and O. C. Van Hyning.

[3] Lack of space prohibits the inclusion of the comprehensive synonymy prepared by Dr. Smith, and of the list of specimens examined.—Ed.

ever, a comparison of the hemipenial structure of the two species affords convincing evidence of their separate generic status (cf. Cope, Ann Rept. U. S. Nat. Mus., 1898, 1900: pl. 23). Not only do the hemipenes of the two genera differ rather widely from each other, but the number of internasals and the type of color pattern are also different. In their combination these differences, in my opinion, give ample evidence of the validity of both *Farancia* and *Abastor*.

The first description applicable to *Farancia*, known to me, was given by Daudin (Hist. Nat. Rept., 6, 1803: 341). His description is sufficiently detailed to make practically certain that the snake he described was the eastern subspecies of *F. abacura*. However, Daudin erred in applying to it the Linnaean name *Coluber ovivorus*. The latter name is based upon a specimen secured by Kalm (perhaps collected in northeastern United States, where he traveled), having 203 ventrals and 73 caudals. These scale counts very definitely are not applicable to *Farancia*. Moreover, they are not readily applicable to any snake occurring in the region in which Kalm traveled. Since the type is lost, the Linnaean name *ovivorus* is therefore unidentifiable. However, Daudin's *ovivorus* does not become available for *Farancia abacura* by reason of the indeterminate nature of *ovivorus* Linnaeus, as Dr. Stejneger kindly pointed out in reply to my inquiry regarding this point. His statement was:— "an unidentifiable name is *not* a *nomen nudum*. If the name is accompanied by a description, indication, or a literary reference, it is available and can never be used again for another species. That a name is 'unidentifiable' means only that it is unidentifiable by you or at the present time."

It is therefore obvious that *ovivorus* Daudin is preoccupied by *ovivorus* Linnaeus.

Three available specific names have been applied to *Farancia: abacura* Holbrook (No. Amer. Herp., 1, 1836: 119, pl. 23), *reinwardtii* Schlegel (Essai Phys. Serp., 1, 1837: 173) and *drummondii* Gray (Zool. Misc., 1842: 68). The type locality of *drummondii* was erroneously given as "California." Lacking a definite type locality, the subspecific identity may be determined by Gray's statement (*l. c.*) that *drummondii* has the "lower sides with alternating black and white bands meeting in the center." Since complete bands apparently never occur in the western subspecies, but are frequently present in the eastern form, especially the young, I conclude that *drummondii* is applicable to the eastern subspecies. In this connection, it is of particular interest to note Boulenger's statement (Cat. Snakes Brit. Mus. 2, 1894: 292) that the type is a young specimen.

The original description of *reinwardtii* does not include details of color pattern, knowledge of which is necessary for determination of the subspecies; fortunately, however, a sufficiently definite type locality is stated—Louisiana. Since the range of the western subspecies completely covers this state, the identity of *reinwardtii* is obvious.

Determination of the identity of *abacura*, however, is not so simple, yet of prime importance since the name is the earliest available in the genus. The type locality has been accepted as South Carolina, largely because of Holbrook's statement: "I have seen this animal only in South Carolina." How-

ever, two facts throw doubt upon this conclusion: first, Holbrook's subsequent statement that " . . . Professor Green, of Philadelphia, has received it from the Mississippi, in the vicinity of New Orleans . . . ," and second, the citation by Yarrow (Bull. U. S. Nat. Mus., 24, 1883: 13) and Cope (Ann. Rept. U. S. Nat. Mus., 1898, 1900: 742) of two "types," USNM 7291, from Prairie Mer Rouge, Louisiana. The plate illustrating *abacura* in Holbrook's 1842 edition of the *Herpetology of North America* (the only edition available to me) sheds no light upon the situation, for the color pattern shown is more or less intermediate between that of the eastern and western subspecies.

The question regarding type locality was referred to Dr. Leonhard Stejneger, who very kindly replied as follows:

In the first edition Holbrook uses the exact wording with regard to the habitat of the species as in the second. The restriction of the type locality to South Carolina by all subsequent writers was naturally influenced by Holbrook's own statement that he had seen "this animal only in South Carolina" leaving it conjectural whether he had seen any of Professor Green's specimens from the vicinity of New Orleans. This selection of South Carolina seems consequently to be justified and should stand *unless* Holbrook's description and plate makes it *absolutely* certain that he drew them exclusively from Louisiana specimens.

And here you run into a difficulty: Both the plates and texts of the two editions of Holbrook differ somewhat.

In the first edition, on p. 120, the description of the colors reads in part as follows: "the whole superior surface of the back and tail is black; the sides are marked with about sixty *transverse bands* [underlined by me] of bright red." This paragraph in the second edition, p. 112, reads as follows: "the whole superior surface of the animal is bluish black; the sides are marked with about sixty *transverse blotches* [underlined by me] of bright red." The plate of the second edition is redrawn in practically the same position as in the first edition, but the coloration is different: the upper parts are deep bluish black and the red much brighter. In the first edition the dark part is much paler and the reds duller and not so scarlet, but the main difference is that in the first edition the red bands extend much higher on the back, at the highest point coming within 3 scales of the upper outline, as against 5 or 6 in the second edition. It would then seem as if the original (1836) plate was based on a South Carolina specimen and that the second (1842) plate was modified from Louisiana specimens.

Yarrow's use of the word "type," as quoted by you, has no base on fact. It possibly means that those specimens were regarded by him as "typical." Cope—or his compiler—simply copied Yarrow.

From the foregoing it seems clear that the two subspecies should be known as *Farancia abacura abacura* (Holbrook), type locality South Carolina, and *Farancia abacura reinwardtii* (Schlegel), type locality Louisiana.

Farancia abacura abacura (Holbrook)

(Eastern Horn Snake: Plate 1, Figs. 1 and 2)

TYPE LOCALITY.—South Carolina.

DIAGNOSIS.—Distinguished from *reinwardtii* by having the light ventral color extending onto sides of body in the form of narrow bars not abruptly terminated dorsally, but becoming gradually narrower and terminating in a point or diffusing into the general darker color of the dorsum; light bars on neck separated by usually no more than three or four median scale rows; distal light bars on tail frequently uniting medially; young with numerous complete or nearly complete light bands about body, especially anteriorly; usually (70%) 53 or more light bands on body; males usually (90.5%) with 13 or more light tail bars, females usually (68.4%) with eleven or more.

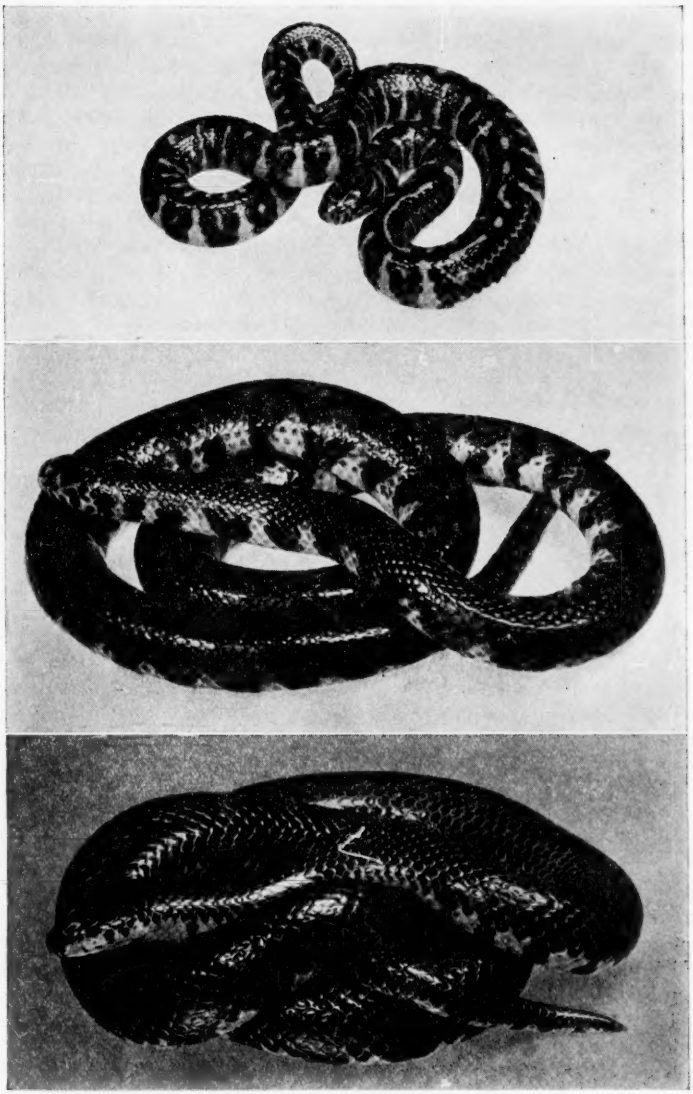

Plate 1

Fig. 1. *Farancia abacura abacura.* A young specimen from Miami, Florida (FNB).
Fig. 2. *Farancia abacura abacura.* An adult specimen from Leesville, South Carolina (LB).
Fig. 3. *Farancia abacura reinwardtii.* An adult from Houston, Texas (HKG 4409).

SCUTELLATION.—Head depressed, snout truncate; rostral low; internasal single, separated from loreal; prefrontals nearly twice as broad as long, entering orbits; supraocular narrow, twice as long as broad; frontal one-half longer than broad, pentagonal, anterior border slightly convex, lateral sides slightly convergent posteriorly, angle of posterior edges about 60 degrees; parietals two-thirds longer than broad; nasal divided below; loreal narrow, twice as long as broad, or slightly less; no preocular; usually two postoculars, rarely one or three; temporal formula usually 1 + 2, occasionally 1 + 1 + 2 or 1 + 3; supralabials usually seven, rarely eight, third and fourth entering orbit, fifth the highest, sixth the largest; diameter of orbit slightly less than half the distance between snout and anterior border of orbit; infralabials usually nine, occasionally eight, rarely seven or ten; mental small, triangular, separated from chinshields by medial contact of first infralabials; two pairs of chinshields, the anterior somewhat the longer.

Scale rows usually 19 throughout length of body, rarely 20 or 21 anteriorly, rarely 18 posteriorly; scales smooth, not pitted; ventral plates 170 to 199, average 189; caudals divided (rarely a few basal caudals entire), 31 to 55, average 40.

COLORATION.—Dorsal ground color black, dark blue-gray, or dark brownish-black; dorsal head-scales, including labials, outlined with cream color; infralabials, chinshields and many of the gular scales with a median dark spot; light areas of belly reddish-orange posteriorly, the color fading anteriorly (all cream-colored in long-preserved specimens); belly with distinctly outlined dark spots, their edges usually coinciding with the edges of the ventrals, extending the full width of the belly or split medially, and separated by light areas of approximately equal length; the light areas continuing on the sides of body, gradually diffusing into the dark ground color, or terminating dorsally in a sharp point; anterior light bars separated from each other medially by a dark area usually three or four scales wide; the distal light bars on tail frequently uniting dorsally.

VARIATION.—The supralabials are eight on one side of two specimens of the 86 examined; the infralabials are 7–8 in one, 8–9 in three, 10–10 in one; postoculars three on one side of one specimen, one on one side of another; temporals 1 + 1 + 2 on one side in two, on both sides in one; temporals 1 + 3 on both sides in one; preanal divided in 75 of 80 specimens examined.

SEXUAL VARIATION.—The number of ventrals and number of caudals are remarkably different in the two sexes. In these characters, no overlap exists; the ventrals in males range from 170 to 180 (average 175), in females from 189 to 199 (average 194); caudals in males range from 44 to 53 (average 48), in females from 31 to 43 (average 37). As pointed out in the diagnosis, the number of light bars on the tail also differs between the sexes. The tail-total length ratio is also diagnostic of sex; males vary from .141 to .181 (average .161), females from .082 to .138 (average .1_).

Males differ from females still further in the possession of very distinct supra-anal keels. The keels are very feebly visible in large females. The maximum length of females is 1760 mm.; of males, 1090 mm. Of the 99 specimens examined, 26 are males; the proportion is 26.3 per cent.

YOUNG.—Young specimens normally differ from adults only in coloration. However, a brood of nine young from Ft. Lauderdale, Florida, extracted from the eggs at various stages of development from 30 to 48 days, shows some unusual variations not found in adults or other young examined. Two have 6 supralabials on each side; the infralabials are 7–9 in one, 8–8 in one, 8–9 in two and 9–9 in four. The tail-total length ratio varies from .115 to .137 in three females, and from .168 to .176 in three males.

Three of these specimens are abnormal in ventral scutellation, many of the scales being divided on the midventral line. Furthermore, there are more scales on one side than on the other. The latter phenomenon is most pronounced at positions on the body where there is a sharp bend produced by crowding in the egg. The caudal scales of one are quite irregular in size, shape and number.

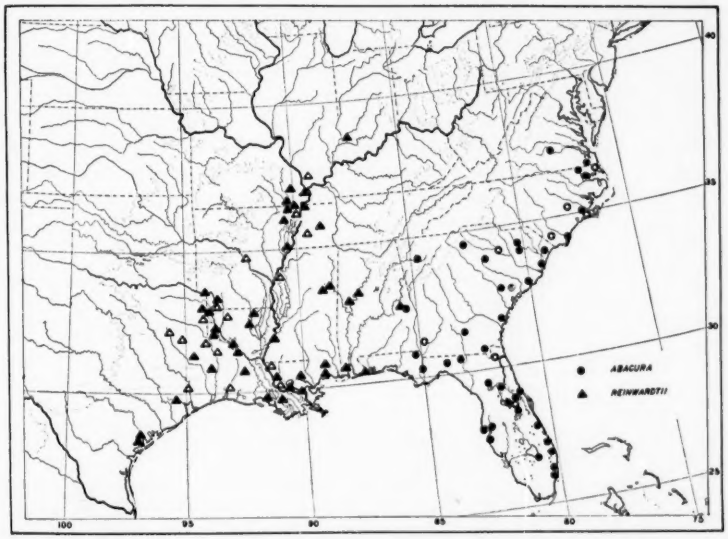

Fig. 1. Distribution of *Farancia a. abacura* and *F. a. reinwardtii*. Solid symbols indicate localities from which specimens have been examined; hollow symbols indicate localities accepted on the basis of reports in the literature.

Five of the nine specimens have the typical coloration of *abacura;* two have a coloration typical of *reinwardtii*. One specimen has the typical *abacura* pattern posteriorly, but the pattern anteriorly is typical of *reinwardtii* except for a complete light band just behind the head. Lastly, one specimen possesses an intermediate pattern—some of the light bars are complete or nearly so, while others terminate abruptly as in *reinwardtii*.

In the two 30-day males, and the single 37-day male, the hemipenes are everted; in the 44-day and 48-day males, the hemipenes are retracted.

DISTRIBUTION.—Peninsular Florida northward in the coastal regions to

south-central Virginia (Amelia Co.), westward approximately to the 86th meridian, including the extreme eastern part of Alabama (Fig. 1).

Farancia abacura reinwardtii (Schlegel)

(Western Horn Snake: Plate 1, Fig. 3)

TYPE LOCALITY.—Louisiana.

DIAGNOSIS.—Distinguished from *abacura* in certain details of coloration: at least the anterior light bars abruptly terminated dorsally; posterior bars sometimes terminated in a point, but not diffused into general darker color of dorsum; light bars on neck separated medially from each other by usually eight or nine scale rows; distal tail bands not united medially (except, sometimes, that on tip); young similar to adults, without complete light bands on body; usually (71.6%) 52 or fewer light bands on body; males with usually (81%) 12 or fewer light bars on tail; females with usually (94.5%) 10 or fewer light bars on tail.

SCUTELLATION.—Essentially similar to that of *abacura*.

COLORATION.—Like that of *abacura*, except as stated in the diagnosis. In addition, the head scales are usually not light-edged, unlike *abacura*.

VARIATION.—The supralabials are 6–7 in one, 7–8 in one, and 8–8 in one, of the 76 examined; infralabials 8–8 in three, 8–9 in eight, 9–10 in three, 10–10 in one; postoculars one on both sides in two, on one side in two. Ventrals 168 to 208, average 185; caudals 35 to 51, average 41. Light bars on body 37 to 62, average 49; light bars on tail 9 to 14, average 10. The preanal is divided in 65 of the 76 specimens examined.

In both subspecies of *F. abacura*, there appears to be a general decrease in average tail-total length ratio with increase in body length, in females; in males the average tail-total length ratio increases with the body length.

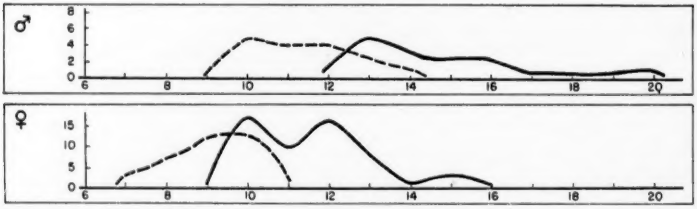

Fig. 2. Variation in number of light caudal bars in *Farancia abacura*. Number of specimens shown on vertical line, number of light bars on horizontal line. *F. a. abacura* indicated by solid line, *F. a. reinwardtii* by broken line.

SEXUAL VARIATION.—As in *abacura*, there is a marked difference in the ventral scutellation between males and females. The ventrals in males vary between 168 and 178, average 172; in females, 185 to 208, average 192. The caudals in males range from 45 to 51, average 47; in females, 35 to 40, average 37.

The number of light bars on the tail in males varies from 9 to 14, average 11; in females, 7 to 11, average 9. The tail-total length proportion ranges in males from .150 to .182, average .165; in females, .101 to .132, average .115.

Males possess distinct supra-anal keels. Of the total number of specimens examined (81), 29 (35.8%) are males.

COMPARISONS.—The character of the light bars on the neck, in my opinion, is of the greatest value in defining the subspecies. In the number of tail bars, 90.5 percent of the *abacura* males have 13 or more, while 81 percent of the *reinwardtii* males have 12 or less; 68.4 percent of the *abacura* females have 11 or more, while 9.5 percent of the *reinwardtii* females have 10 or less. The total overlap in either sex is considerably less than 20 percent.

The differences between the markings of the young are most striking. The young of *abacura* have numerous complete or nearly complete light rings encircling the body, while the young of *reinwardtii* are like the adults of the same subspecies.

INTERGRADES.—Only one specimen, which is referred to *reinwardtii*, have I considered an intergrade. This specimen (Cornell Univ. No. 1108) is from Auburn, Alabama. Another specimen from the same locality (Cornell Univ. No. 1107) is typical *abacura*. In the intergrade, the anterior light bars, except that immediately behind head, are very broad. However, they extend far toward the middorsum, separated from each other by only four or five scale rows. The extreme anterior light band is narrow, pointed, and lacks but three scale rows of being complete dorsally.

DISTRIBUTION.—Extreme western Florida northward in the lowlands to southern Indiana and southeastern Missouri; westward along the coast to about the 97th meridian (Fig. 1).

CHICAGO ACADEMY OF SCIENCES, CHICAGO, ILLINOIS.

Amphibians and Reptiles of Eastern Quebec

By HAROLD TRAPIDO and ROBERT T. CLAUSEN

WHILE in eastern Quebec from August 17 to September 19, 1937, we collected 138 specimens of reptiles and amphibians. Most of these were obtained in the area south of the St. Lawrence River, although a few were also taken to the north, in the region of Lake St. John. Since few herpetological collections are available from eastern Quebec and the literature on the herpetology of this region is scanty, it seems desirable to report our findings, with an attempt to summarize the herpetological information for this general area.

For their kindness and assistance to us during the preparation of this paper, we desire to express appreciation to Mr. C. L. Patch of the Canadian National Museum, to Dr. Doris Cochran of the United States National Museum, to Mr. Arthur Loveridge of the Museum of Comparative Zoology, and to Mr. Charles Bogert of the American Museum of Natural History, who have permitted us to examine the collections of their respective institutions; to Mr. E. B. S. Logier, for records of specimens in the Royal Ontario Museum of Zoology; and to Dr. and Mrs. A. H. Wright, who have made helpful suggestions and examined some of our material.

In the text, names of museums have been abbreviated as: CNM, Canadian National Museum; CUM, Cornell University Museum; MCZ, Museum of Comparative Zoology; ROM, Royal Ontario Museum of Zoology; and USNM, United States National Museum. Specimens collected by us during 1937 and to be deposited in the Cornell University Museum are simply listed by number after our initials TC; while records from the literature are followed by the author and date of publication. Duplicate collections, so far as they are available, will be deposited in the United States National Museum and in the Museum of Zoology of the University of Michigan.

List of Species

Necturus maculosus maculosus (Rafinesque)

Quebec Co.: Quebec, found commonly in winter, Provancher (1874–75).

Triturus viridescens viridescens (Rafinesque)

Gaspé Co.: Third Lake, about 12 miles west of the village of Gaspé, Ball (1937); valley of Grand Pabos, Cox (1899b); basin of York River, Cox (1899b); basin of Dartmouth River, Cox (1899b).

Not found by us, possibly because we did not investigate aquatic habitats. Cox (1899b) did not find the terrestrial form on the Gaspé Peninsula, although it occurs in New Brunswick.

Ambystoma jeffersonianum (Green)

Gaspé Co.: Reported from Grand River, Cox (1899b).

Ambystoma maculatum (Shaw)

Rimouski Co.: Bic, USNM 26394. Gaspé Co.: Grand Greve, Ball (1937); 16 miles west of town of Gaspé, Ball (1937). Quebec Co.: Cap Rouge, Provancher (1847–75). "St. Lawrence, Canada," MCZ 208.

Plethodon cinereus (Green)

Sherbrooke Co.: 3 miles northeast of Sherbrooke, TC 303. Gaspé Co.: Courcelette Tp., 13 miles inland on Ste. Anne des Monts River, TC 315; Seigneurie de Mont-Louis, southwest base of Mont St. Pierre, TC 321; Cape Rosier Tp., southwest of Cap des Rosiers, TC 324; Percé Tp., southern base of Mt. Ste. Anne, TC 325. Bonaventure Co.: Restigouche River, 5½ miles south of Matapédia, TC 335; Matapédia, MCZ 19399. Lake St. John Co.: Val Jalbert, Ouiatchouan River, TC 338.

Common in eastern Quebec. About three-quarters of the specimens were red-backed, differing from New York material in that the dorsal stripe is pink rather than orange red. We collected this species in the usual habitats under stones and logs, with the exception of one specimen taken at Cap des Rosiers, which was found under moss on the face of a vertical limestone cliff.

Eurycea bislineata bislineata (Green)

Sherbrooke Co.: Sherbrooke, CNM 1408.

We assign only one lot from Quebec to this subspecies.

Eurycea bislineata ***major,*** n. subsp.

Type.—USNM 104239 (TC 339), adult male, under limestone slabs along Ouiatchouan River, Val Jalbert, Lake St. John Co., Quebec, September 17, 1937.

Paratypes.—Gaspé Co.: Lesseps Tp., Lac aux Americains, alt. 2300 ft.,

CNM 1065. BONAVENTURE Co.: Hamilton Tp., 7 miles inland on Bonaventure River, TC 327; 5 miles south of Matapédia, on Restigouche River, TC 336. LAKE ST. JOHN Co.: Ouiatchouan River at Val Jalbert, TC 339. SAGUENAY Co.: Godbout, USNM 48056, 24081–2. "St. Lawrence," MCZ 240.

DIAGNOSIS.—Like *Eurycea b. bislineata,* but larger, with relatively longer tail, more diffuse coloration, 16 or occasionally 17 costal folds, and males with a broad dorsal protuberance at base of tail.

DESCRIPTION OF TYPE.—Costal grooves 16; intercostal grooves between appressed toes 4; head ovate, broadest behind angle of jaw; eye about same length as distance from tip of snout; naso-labial grooves only very slightly swollen; gular area swollen; line of mouth terminating behind eye, closely approaching groove under eye; a groove from posterior angle of eye along side of head, becoming decurved to join gular fold at an angle of 90°; skin smooth, with rows of pores from nostril to rear of eye, along jaw, and dorsolaterally on body; series of parasphenoid teeth from rear of eye sockets almost to base of skull, elongate and parallel, with intermediate space equal to width of the rows; series of vomerine teeth approaching the parasphenoid series posteriorly and divergent toward nares (dentition based on dissection of cotypes); tail terete at base, becoming compressed distally, with a dorsal protuberance at base; limbs somewhat compressed; fingers, in order of length, 3, 2, 4, 1; toes 3, 4, 2, 5, 1; anal slit lined with papillae; back dark yellowish, dotted with black, bordered on each side with a dark line from rear of eye, along body, and slightly less than ⅓ of tail; sides spotted and mottled with black; coloration in general diffuse; chin, throat, and belly slightly dotted; underside of tail more dotted; total length 111 mm.; head 8.7 mm.; body 39.7 mm.; tail 62.6 mm.; greatest diameter of head 7.4 mm.; greatest diameter of body 6.5 mm.

REMARKS.—The average total length of 16 specimens from the Ouiatchouan River is 96.06 mm., while specimens of *E. b. bislineata* from the middle Atlantic states and New York average 60.6 mm. The salamanders from the Ouiatchouan River, measured in the field when freshly killed, had the tail comprising from 53% to 60% of the total length, while Dr. S. C. Bishop has informed us that measurements of New York *E. b. bislineata* show the tail to be from 46.4% to 53.5% of the total length. The largest specimens of *E. b. bislineata* recorded by Dunn (1926) were from Ottawa. Specimens from Ottawa and from Hull, Quebec, examined by us, agree with our concept of *E. bislineata major.* In our series of *E. bislineata major* from the Ouiatchouan River the costal folds are 16, occasionally 17, while specimens of *E. b. bislineata* from New York have 16 or more rarely 15. The rather prominent glandular protuberance at the base of the tail in males of *major* is like that of *Eurycea multiplicata,* described by Noble (1929: 4; 1931: 118–119). Certain New York specimens of *E. b. bislineata* show a tendency toward this character, but less well developed than in our Canadian specimens.

We have examined the types (USNM 4735) of *Eurycea bislineata borealis* (Cope, 1889: 165) from Lake Oquassa, Maine. They appear to be typical *E. b. bislineata,* and do not agree with *major.*

Bufo americanus americanus Holbrook

MEGANTIC CO.: 2 miles northeast of Thetford Mines, TC 304. MONTMAGNY CO.: Montmagny, TC 309. RIMOUSKI CO.: 1 mile west of Bic, TC 312. BONAVENTURE CO.: New Richmond Tp., Little Cascapedia River, 11 miles inland, TC 330; Restigouche River, 5½ miles south of Matapédia, TC 334. Cox (1899b) found the toad common on the Gaspé Peninsula.

Toads from the south shore of the St. Lawrence River west of the Gaspé Peninsula, and from the river valleys of the south side of the peninsula, agree with this subspecies. A male from Montmagny has a well developed middorsal light stripe, but otherwise shows the characters of *B. a. americanus*. Occasional toads from New York, particularly breeding females, may have a light middorsal stripe. A specimen from Bic is unfortunately badly desiccated, but shows evidence of the light middorsal stripe and pink coloration of *B. americanus copei*. This may represent an intermediate between the two subspecies.

Bufo americanus copei Henshaw and Yarrow

GASPÉ CO.: Valley of Ste. Anne des Monts River, from 3 miles inland to the northern base of Mt. Albert, TC 313, 319, 320. SAGUENAY CO.: Godbout, ROM 592; Matemek River, USNM 73844–5; Cape Whittle, CUM 3303; Mary River, USNM 37721; Seal River 30 miles east of Moisie, H. W. Jackson; Seven Islands Bay, Speck (1925).

Toads common in the valley of the Ste. Anne des Monts River, Gaspé Peninsula, differ strikingly from typical *Bufo a. americanus*. Comparison at the Canadian National Museum with material of *B. americanus copei* from Moose Factory and from Cape Hope Islands in James Bay, demonstrated that our toads were that subspecies. The coloration is much brighter than in *a. americanus*, with the black spots of the back fused on the sides to form broken bands and blotches. These markings are usually so arranged that there is a broad light middorsal band, and frequently a light lateral stripe on each side, from the parotoid to the insertion of the hind limb. Our specimens also resemble *B. a. copei* in the pink coloration in the axils of the limbs and in the pink tipped warts over the dorsal body surface, as Cope (1895: 286) noted for a specimen from Moose River, British America, which he assigned to *copei* of Yarrow and Henshaw, although he did not consider that form valid. The parotoids not only are long and narrow, as Gaige (1932) has pointed out, but tend to be constricted towards their middle, while the chest and belly are speckled, or in some individuals strongly mottled with black.

Sexual dimorphism is pronounced in a pair of living specimens which we have examined from Seal River, on the north shore of the St. Lawrence River. The female is brilliantly colored with black and pink dorsally, and with black marbling ventrally, while the male is a drab yellow brown, with the black and pink much less pronounced and the middorsal stripe lacking. The underside of the male is spotted with black, though not so extensively as in the female. The parotoids of both male and female are narrow and long, while the cranial crests are well spaced. Our collections from the Ste. Anne River differ from this pair in that the males are as brilliantly colored as the females.

Hyla crucifer Wied

RIMOUSKI CO.: 1 mile west of Bic.

We found only one specimen, although Cox (1899b) reported it calling commonly in all the river valleys of the Gaspé.

Rana catesbeiana Shaw

MEGANTIC CO.: 1 mile southwest of Black Lake, TC 306.

Apparently absent on the Gaspé Peninsula. Our only specimen is from the southern part of the province. Provancher (1874–75) reported this frog as rather rare around Quebec.

Rana clamitans Latreille

BONAVENTURE CO.: 11 miles inland on Little Cascapedia River, TC 331. SAGUENAY CO.: Godbout, USNM 45397–9, ROM 381–2, 1766–72. QUEBEC, USNM 3472.

Frogs of this species from the valley of the Little Cascapedia River had the dorso-lateral folds pronounced and were much spotted on the back, but not mottled as in *Rana septentrionalis*. Cox (1899b) reported it as rather uncommon on the Gaspé Peninsula.

Rana palustris Le Conte

GASPÉ CO.: Grand Pabos, somewhat rare, Cox (1899a).

Rana pipiens Schreber

MONTMAGNY CO.: Montmagny, TC 308. TEMISCOUATA CO.: Rivière du Loup, TC 310. GASPÉ CO.: Cap des Rosiers, TC 322; Gaspé Basin, St. Johns River, CNM. ANTICOSTI ISLAND: English Bay, MCZ 5943, 5947. LAKE ST. JOHN CO.: Val Jalbert, Ouiatchouan River, TC 340. QUEBEC CO.: Cap Rouge, TC 307; Quebec, Provancher (1874–75); "Quebec," USNM 3388, 3416.

The necessity of naming our Quebec specimens has led us to a consideration of the evidence which Kauffeld (1937) has presented to establish *Rana brachycephala* as the meadow frog of southern Canada and of a large part of the United States. The primary character used in the separation of the two supposedly distinct species is the length of the head as compared with the total length. As Kauffeld defines *brachycephala*, the head length enters the body 3.5 to 4 times; in *pipiens* 3 to 3.5 times. The following data are for specimens from widely scattered localities from within the range assigned to *R. brachycephala* by Kauffeld (figures represent head length divided into total length).

Locality	No. of specimens	Lowest	Highest	Average
Eastern Quebec	11	2.6	3.2	2.8
Dorset, Ontario	3	2.6	3.0	2.7
Anticosti Island	2	2.5	3.1	2.8
Penobscot Co., Maine	16	2.5	3.0	2.7
Tioga Co., New York	4	2.7	3.2	2.9
Genesee Co., New York	7	2.9	3.1	3.0
Rockland Co., New York	5	2.5	3.0	2.7
Orange Co., New York	1	2.5	2.5	2.5
Spicer, Minnesota	12	2.5	3.2	2.8

These measurements may be compared with those of specimens from the range assigned by Kauffeld to *R. pipiens*:

Locality	No. of specimens	Lowest	Highest	Average
Lakehurst, New Jersey	2	2.7	2.9	2.8
Morris Co., New Jersey	1	2.4	2.4	2.4
Union Co., New Jersey	1	2.8	2.8	2.8

There is a wide range of variation in this character, with no significant correlation with range.

The second character employed by Kauffeld is that the tibiotarsal articulation does not reach the snout in *brachycephala*, while it just reaches the

snout in *pipiens*. As preserved material does not often readily permit the leg to be bent forward to the head, we measure the distance from the insertion of the leg to the tip of the snout and from the same point to the tibio-tarsal joint. In the same material from the range of *brachycephala* as was used above [1] the results are as follows:

No. of mm. difference	Frequency	No. of mm. difference	Frequency
leg 6 mm. shorter than body	1	leg 4 mm. longer than body	4
leg 3 mm. shorter than body	1	leg 5 mm. longer than body	7
leg 2 mm. shorter than body	4	leg 6 mm. longer than body	2
leg 1 mm. shorter than body	2	leg 7 mm. longer than body	2
leg equal to body	7	leg 9 mm. longer than body	1
leg 1 mm. longer than body	13	leg 10 mm. longer than body	1
leg 2 mm. longer than body	11	leg 13 mm. longer than body	1
leg 3 mm. longer than body	7		

Thus by direct measurement the leg exceeds the distance from the insertion of the leg to the snout in five-sixths of the specimens.

The remainder of the characters are equally unsatisfactory. Specimens of *Rana sphenocephala* from the Okefinokee Swamp in Georgia have the toes as extensively webbed as in specimens from Dorset, Ontario; the dorso-lateral folds in large *sphenocephala* from Georgia extend on to the head in the ocular region as they do in large specimens from the north; and since in a series of several hundred live *"brachycephala"* from Alburgh, Vermont, the external vocal sacs are well developed even this supposedly important character fails.

The material collected in Quebec, therefore, as well as specimens from widely scattered stations within the range which Kauffeld has assigned to *brachycephala*, fail to confirm his conclusions. It seems better for the present to refer the northern specimens to *pipiens*, until all the available material of this widespread and perplexing species can be studied.

Cox (1899b) reported the leopard frog as rather uncommon, although observed in every river valley of the Gaspé; while Verril (1862) mentioned seeing it at Gaspé, C. E.

Johanson (1926) states that frogs were not native on Anticosti Island and that Schmidt (1904) recorded the introduction of *R. pipiens* in 1899, from the vicinity of Quebec City. In 1923 these frogs were still confined to Ellis Bay, where they were originally released.

Rana septentrionalis (Baird)

GASPÉ CO.: Third Lake, 12 miles west of Gaspé Village, Ball (1937). SAGUENAY CO.: Godbout, ROM 668–70.

Although Cox (1899b) found this frog common in all suitable places on the Gaspé, we did not once see it.

Rana sylvatica sylvatica Le Conte

SHERBROOKE CO.: 3 miles northeast of Sherbrooke, TC 302. MEGANTIC CO.: 1 mile southwest of Black Lake, TC 305. QUEBEC CO.: Quebec, more common than *Rana clamitans*, Provancher (1874–75).

[1] With the addition of Boulenger's measurements (1920: 440) of 4 specimens from Lucknow, Ontario, one from Westbourne, Manitoba, and 3 from Moose Jaw, Saskatchewan.

A review of the available evidence convinces us that *Rana sylvatica* and *R. cantabrigensis* are races of the same species, necessitating the trinomial.

Rana sylvatica cantabrigensis Baird

GASPÉ CO.: Lapotardiere Tp., 13–21 miles inland on the Ste. Anne des Monts River, TC 316; northern summit of Mt. Albert, TC 317; Cap Rosier Tp., below high cliffs at Cap des Rosiers, TC 323; Gaspé Basin, CNM 589; also several other collections by Ball (1937). BONAVENTURE CO.: Hamilton Tp., 6 miles inland on the Bonaventure River, TC 328. SAGUENAY CO.: Pointe aux Alouettes, TC 337; Mingan Islands, Harbor Island, MCZ 834; Seven Islands Bay, Speck (1925). LAKE ST. JOHN CO.: Val Jalbert, Ouiatchouan River, TC 341. "Quebec", USNM 3388.

Rana cantabrigensis has been separated from *R. sylvatica* as a species because of certain color differences and different relative measurements. It is a smaller and more stocky frog than typical *R. sylvatica*. This is shown by a comparison of the length of the tibia with the total length, the diameter of the tibia with its length, and other measurements. Typical *cantabrigensis* is remarkable for a light median dorsal stripe and sometimes a similar light stripe on the thigh and tibia. Schmidt and Necker (1935) have revived the name *latiremis* for the short-legged, stocky frogs from the north, while, on a basis of the color characters, they have referred wood frogs from Illinois, Indiana, and Michigan to *R. c. cantabrigensis*, despite the body proportions, which are like those of *R. sylvatica*. The color characters, as Wright and Wright (1934) have already pointed out, are not constant. We find this inconstancy to be true not only for wood frogs from the north central states, but also for those from the region of Hudson Bay. The Hudson Bay frogs which lack the striping do not differ structurally from the striped ones. Color characters can not, therefore, be considered as absolute criteria for the separation of the two forms.

Since series of measurements of frogs from various localities in the ranges of *R. sylvatica* and R. *cantabrigensis* demonstrate that there is no sharp break between the two populations, it seems evident that these forms are best regarded as subspecies. For their differentiation, we prefer the comparative structural characters which show some north to south geographic correlation, rather than color characters, which are apparently variable over the entire range of *R. cantabrigensis*. Schmidt (1938) has independently come to a similar realization of the north to south variation in body form of these frogs. We prefer to give nomenclatorial recognition only to this variation in body form, which has some geographic correlation, and not to color variations which apparently lack such correlation.

R. cantabrigensis is usually separated from *R. sylvatica* by the length of the tibia, which is less than half the total length in the former and greater than half in the latter. The heel extends beyond the snout in *sylvatica*, but does not reach the snout in *cantabrigensis*. Specimens from the Gaspé Peninsula and from the north shore of the St. Lawrence in eastern Quebec are somewhat intermediate in these arbitrary characters, but are here referred to *s. cantabrigensis*.

At an altitude of about 3800 ft., we collected 37 wood frogs from the sphagnum bordering a small alpine pond along the northern rim of the summit of Mt. Albert, Gaspé Peninsula. Of 36 individuals preserved, 5 lack

the left hind limb, 1 lacks the right hind limb, 2 lack the right foot, and 1 has the metatarsals and phalanges of the left foot reduced to about one-half the size of those on the right foot. The one legged frogs collected do not by any means represent a selection from the population, as the many individuals which eluded capture could be recognized at once by the flash of white belly which they showed in jumping, due to their unbalanced spring. Despite their handicap, they seemed no less agile than normal individuals. Wright (1932) found that deformed frogs in the Okefinokee Swamp in Georgia were individuals which had been attacked by predatory turtles, but on Mt. Albert this does not seem likely, since turtles have never been recorded either from the Gaspé Peninsula or from the country directly south. It might be assumed that some other animal preys on these frogs, but the only small mammal which Goodwin (1924) found above tree line on the table-land of Mt. Albert was *Microtus pennsylvanicus fontigenus*, which would not be likely to attack frogs or tadpoles. While some other external agency may have been operative, the high percentage of limbless individuals leads us to suppose that some genetic factor may be involved.

Cox (1899b) reported this frog as rare on the Gaspé Peninsula.

Diadophis punctatus edwardsii (Merrem)

MONTMORENCY CO.: St. Joachim, Provancher (1874–75).

Opheodrys vernalis (Harlan)

Cox (1899b) observed this snake at several places on the Gaspé Peninsula.

Storeria occipito-maculata (Storer)

SHERBROOKE CO.: 3 miles northeast of Sherbrooke, TC 301. QUEBEC CO.: Cap Rouge, Provancher (1874–75).

The one red-bellied snake collected was uniform brown dorsally. In alcohol, the edges of the abdominal plates are less gray than in most specimens from the northeastern states.

Thamnophis sirtalis sirtalis (Linné)

GASPÉ CO.: Courcelette Tp., 12 miles inland on the Ste. Anne des Monts River, TC 314; Percé Tp., summit of Mount Ste. Anne, TC 326; Gaspé Basin, CNM, also Ball (1937). SAGUENAY CO.: Godbout, USNM 45324–33, 45337, 49575, ROM 3875; Tadoussac CNM; Matamek River, CNM; 27 miles east of mouth of Romaine River, CUM 1294.

The two garter snakes collected have the longitudinal stripes obscure and the checkered pattern prominent.

In traveling up the Ste. Anne valley with a farmer who had passed all his life there, we were assured that snakes did not occur in the country and that it was useless to look for them. A little later, when we showed him a specimen which we collected in the brush beside the trail, it was obvious from his horror that he had never before seen a snake.

Provancher (1874–75) reported that this snake is found everywhere in the province, while Cox (1899b) remarked that he had seen more than one "variety" of garter snake in the Gaspé and Maritime Provinces.

Chrysemys picta picta (Schneider)

Reported as very rare around Quebec by Provancher (1874–75).

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A Note on Variation in Squamation of the Cheek Operculum in Two Etheostomid Fishes from Quebec

By Laurence R. Richardson

THE fresh waters of Southern Quebec are distinguishable into two faunistic zones, the lowland waters of the St. Lawrence River Valley and the highland waters of the Laurentian and the Appalachian formations. The waters of the latter districts, while tributary to the St. Lawrence, are faunistically poorer than the waters of the St. Lawrence itself. Such species as *Ictalurus punctatus, Villarius lacustris, Carpiodes cyprinus, Moxostoma anisurum, Esox maskinongy, Stizostedion canadense, Aplites salmoides,* and *Cottus bairdii bairdii,* as well as many others, are all common in the waters of the St. Lawrence River but do not penetrate into the waters of the highland formations. Others, such as *Salvelinus fontinalis* and *Cottus cognatus,* are virtually restricted to the waters of the latter districts, although it is difficult to determine whether this restriction is the result of modification of the lowland waters, or not.

About thirty species range freely from the lowland into the highland waters, and during the course of a study of the fishes in the Appalachian district of the province conducted by the Provincial Hatchery Service it became apparent that in certain species there is a distinct variation between the individuals taken from the waters of the St. Lawrence River and others taken in the mountainous highland waters.

Such variation has been found most marked in the two etheostomid fishes *Boleosoma nigrum olmstedi* (Storer) and *Poecilichthys exilis* (Girard). The former is common in the waters of both districts; the latter has an irregular distribution in the mountain areas but is relatively more common in the St. Lawrence. In addition to the more subtle variations in color and proportions which are present in these species but difficult to define, there are distinct variations in the extent of squamation of the face and the operculum. Such variation has been observed also in *Stizostedion vitreum* (Mitchill) and *Percina caprodes* (Rafinesque), but owing to lack of sufficient material from both localities, it is not yet possible to define its extent.

Specimens of *B. nigrum olmstedi* from the St. Lawrence agree closely with the descriptions of this subspecies as given in standard works. The cheeks and opercula are completely covered with normally developed scales. The breast is typically scaled, and the nape naked. Specimens from the waters of the mountain districts, on the other hand, have the cheek and opercle naked. Otherwise, both series of specimens are closely similar, although spawning adults from Brome Lake and from Lake St. Francis in the Appalachian area were much heavier in the body, had larger fins, and were more densely black than comparable specimens taken from the St. Lawrence River in the immediate vicinity of Montreal. This latter variation in the form and coloration of the spawning adult does not appear as a constant feature, however, in the Appalachian waters since the majority of the adult specimens taken in the mountains resemble more closely those from

the St. Lawrence than those other aberrant and more highly colored forms from Brome Lake and Lake St. Francis.

On close examination, it is found that specimens from the mountainous districts have one, or at most two rows of scales on the face. These are present immediately below the eye and extend up behind the eye to the level of the base of the hyomandibular. There are also several scales in the form of a triangular patch filling in the anterodorsal corner of the operculum but not extending completely over the body of the operculum, which, for the greater part, is bare. These scales are discernible in fresh or preserved specimens, are typically ctenoid, and have many circuli.

This variation between the scaled and the naked face has been recorded for *B. nigrum typica* (Jordan and Evermann, 1896), but is not described as a local variation.

During the course of a general study of the subspecies *olmstedi* by the present writer, several specimens from both the lowland and the highland areas in Quebec were prepared by the Dawson Alizarin process. In these transparencies it was found that in addition to the normal scales upon the face of individuals from the mountains, many small incompletely developed scales were concealed in the skin of the naked area of the cheek which could not be detected until they had been stained. They were less than a third the size of a normal scale, elliptical in form, not ctenoid, and in agreement with their smaller size, possessed only a few, three to five, circuli. In typical specimens from the mountains, these incompletely developed scales rimmed the row of normal ones below and behind the eye and also those forming the patch on the operculum; but in some instances they practically covered the cheek and the operculum.

At one locality (Gear Brook, Missisquoi County) on the edge of the highland area, both types of specimens were present in the same stretch of the brook and collections made at this point show a full range in variation from the normal, fully-clad cheek and operculum of the lowland form to the naked cheek of the highland form in which even the minute scales fail to cover the cheek and the operculum.

P. exilis shows a similar variation. Specimens collected from Black Lake (Megantic County) and Key Brook (Richmond County) in the highland Appalachian area have the cheeks and opercles practically naked with the exception of a line of scales rimming the orbit and a patch on the opercle. On the other hand, specimens from the St. Lawrence River in the vicinity of Montreal have the cheeks and opercles completely covered with fully developed scales. Incompletely developed scales were found in the 'naked' area on the cheek and opercles of specimens from Black Lake after preparation as transparencies.

The degree of squamation of the face and of the opercle has been considered a valuable diagnostic feature in the earlier taxonomic studies of the Etheostomidae on this continent. Hubbs (1926) has prepared an extensive list of the synonomy of *P. exilis*, and in checking the descriptions of these synonyms, I find that much stress has been placed on the squamation of the face and the opercles without recognition of variation in these features. This must have contributed materially to the multiplication of the synonomy of this species.

In this connection, the case of *Etheostoma* (*Nivicola*) *boreale* Jordan is an example. The type description was based on a small series from the vicinity of Montreal, and Jordan (1929) bases the validity of the species on the presence of a humeral scale on his specimens. While I am unaware of the exact source of his material, I can say definitely that many atypical specimens of *P. exilis* are obtainable locally from old, abandoned quarries. Specimens from these locations characteristically have the head heavier than normal and the body slender, frequently even to the point of emaciation. When taken in the spring, the degree of emaciation is often marked, but individuals taken in the fall, while apparently not emaciated, nevertheless have the head larger than is normal. Black patches are common in the humeral position, but even in stained transparent preparations, no true humeral scale, such as is present in *Catonotus flabellaris*, can be found backing the black patch. In a large collection of normal specimens from the mountain district (Black Lake) a black humeral patch was present on nearly 25 per cent, not on the rest; and even occasionally would be found on the one side of an individual and not on the other.

I would suggest that the material described by Jordan under the name of *Etheostoma boreale* represented a collection of such atypical specimens of *P. exilis* (Girard). Accordingly *E. boreale* should be considered a synonym of *P. exilis* as recommended by Hubbs (1926).

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Notes on the Ranges of Fishes from Lower California and the West Coast of Mexico; with a Discussion on the Use of Diving Apparatus in Making Collections

By Vernon Brock

During the winter of 1938 the author travelled along the coasts of Lower California to collect and observe with diving apparatus the ichthyological fauna of that region. An opportunity was likewise afforded to develop new collecting methods and to compare two types of diving apparatus available for this work.

It was felt that any diving equipment used for biological work in shallow water in the tropics should be as simple as possible without reduction in practicability and that it should give the greatest possible freedom to the diver. The style of apparatus known as the "open helmet" fulfilled these requirements and has been employed by biologists and others to a greater extent than any other type. This is simply a diving helmet without any attached suit, the weights (just enough to give the diver footing) being attached to the breastplate and backplate of the helmet itself. This has proven its usefulness, but it has the fault of partially filling with water whenever the diver attempts to stoop over. This objection is a serious hindrance to observing and capturing small bottom fishes. Furthermore the bulk of the helmet itself is a handicap in working under overhanging ledges and in narrow channels about rocky places generally. On the other hand, helmets of this type usually hold a certain volume of air which, in case of a failure of the air supply, is advantageous. Also as a rule, breathing is natural and easy.

Another type of apparatus used for the first time by the author on this trip was referred to by members of our party as the "face mask." This consisted of a glass-fronted aluminum casting that fitted over the face and was held in place by rubber straps around the head. A rubber "inner tube" was fitted between the face and the aluminum body of the face mask to insure a water- and air-tight fit. An air hose coupling was fitted at the top of the mask and a valve beneath the chin permitted the escape of expired air. The weights necessary to overcome the natural buoyance of the diver were hung in a canvas vest, one on each side of the body. This form of diving apparatus proved to be free from many of the limitations of the open helmet. For example, the whole apparatus weighed about 7 pounds, a favorable contrast to the 65 pounds of the open helmet. The diver did not have to be careful about maintaining a relatively upright position when using the face mask; he could, in fact, lie flat upon the sea floor. The mask had so little bulk that working in and about very rocky places need not be a series of semi-duckings and helmet bumpings that marked attempts at specimen collecting in such places with the open helmet. In fact the face mask was so superior in this respect that it was used almost exclusively for diving on the present expedition. On the other hand it did require a greater volume of air; and it had practically no air reserve, thus lacking an important safety factor in case of a failure of the air supply.

It goes without saying that these collecting methods required a certain amount of skill that could only be acquired through practice and experience, and they required a good deal of patience. The use of a fish spear successfully under water in capturing the larger fishes was for some species a question of patient stalking; for the victims would not allow a diver to approach closer than fifteen or twenty feet. The larger labrids, parrot fishes, and basses like the Jew fish (*Promicrops*) are cases in point. It was not practical to employ a fish spear on small fishes; these were taken in large glass jars as described below. Spears of several kinds were used, but of these, the type with but one large, long-shanked point proved easiest to use.

On the whole, while the use of spears in skillful hands may be considered a more efficient means of collecting about reefs than fishing with hook and

line, other methods such as the use of dynamite are superior to both. And although spears were not our chief instrument for collecting, one was always carried by the diver and used to transfix the occasional careless specimens that became too curious of the diver's strange activities.

Collecting of small bottom fishes was done with a very wide-mouthed glass jar of one gallon capacity. The mouth of the latter was clapped over small unsuspecting fishes resting on comparatively flat places on the bottom. This method was fairly effective for gobies, blennies, and other small bottom dwellers. For other fishes, the mouth might be placed over small openings in the rocks into which formalin would be injected to drive out any fishes that might lurk within. Then again the jar could be either held in the hand or laid sideways upon the sea floor and desired specimens gently herded inside. For certain active and suspicious species this was sometimes a process requiring care and much patience. However, for others, like small pomacentrids and chaetodonts, this method proved less difficult.

Sometimes the jar was baited and left on the sea floor. Crushed sea urchins usually made excellent bait. As soon as a victim had entered the jar the diver attempted to replace the lid before it escaped. This method proved to be especially effective in the capture of labrids. An improved apparatus would be a wire screen cage with a large opening on the top or side and with a screen cover for the opening. The latter could be cocked open and be slammed shut by a powerful spring which the observer could release at will with a string.

Diving apparatus is a valuable aid in supplementing other and more conventional collecting methods. It permits of observing the various species as they are in life. One can learn more about the ichthyological fauna and ecology of a new locality in one dive than in days of collecting by the usual methods.

The species listed below were collected along the Lower California coast by these methods. They are given with the present known range as determined from the available literature, and with the extensions of range as observed by the author.

RHINOBATIDAE

1. *Zapteryx exasperata* (Garman).—San Diego Bay. One taken with fish spear and another observed from the diving helmet at Espiritu Santos Island, Lat. 24° 20′ N., Long. 110° 20′W. These fish might refer to *Z. xyster*, which is known only by the type from Panama; but they differed in not having the black-edged yellow spots on the dorsal side ascribed to the latter species.

HAEMULIDAE

2. *Anisotremus davidsonii* (Steindachner).—Southern California to Port San Bartolome, Lat. 27° 40′ N., Long. 114° 50′ W. Numerous specimens seen at San Juanico Bay. (Lat. 26° 15′ N., Long. 112° 30′ W.)

POMACENTRIDAE

3. *Hypsypops rubicundus* (Girard).—Southern California south to Guadalupe Island (Lat. 29° N., 118° 20′ W.). Taken in poisoned tide pool at Port San Bartolome; numerous specimens seen and some speared at San Juanico Bay.

4. *Pomacentrus rectifraenum* (Gill).—North to Cape San Lucas. Two

specimens taken at San Juanico Bay with a glass jar, and others seen.

LABRIDAE

5. *Halichöres semicinctus* (Ayres).—Southern California south to Cerros Island (Lat. 28° 10′, Long. 114° 50′). Taken in poisoned tide pool at Port San Bartolome; specimens observed from the diving helmet at San Juanico Bay.

6. *Halichöres nicholsi* (Jordan and Gilbert).—Revillagigedo and the Galapagos Islands. One taken in baited jar, few others observed at Cleopha Island. The colors in life of this specimen were as follows: Vertical fins with blue edge followed by band of red with blue spots; black vertical band on side from sixth to eighth dorsal spine; a bright yellow blotch in front of black band one and one-half scale row wide and four scale rows long; bright blue in axial region; a very faint lateral bank; few small yellow spots on scale bases along ventral side; snout green with blue spots; tail olive with seven or eight rows of blue spots and reddish at tip. The specimen differed from *H. sellifer* in not having any red on the body.

7. *Thalassoma duperry* (Quoy and Gaimard).—Abundant about the Hawaiian Islands, and recorded from Taboguilla Island, Panama Bay, by Kendall and Radcliffe. One taken in baited jar at Espiritu Santo Island, few others observed.

CHAETODONTIDAE

8. *Pomacanthus zonipectus* (Gill).—Guaymas to Panama. Two taken in glass jar at San Juanico Bay. Numerous young were seen at this locality but no adults. The two specimens taken (from water of 62° F.) were kept alive until the ship reached San Diego, surviving water temperature as low as 54° F.

ZANCLIDAE

9. *Zanclus cornutus* (Linnaeus).—Warm seas of the Pacific; Revillagigedo, Cocos, and Galapagos Islands. One observed from the diving helmet at Cleopha Island (Lat. 21° 16′ N., Long. 106° 16′ W.).

CLINIDAE

10. *Heterostichus rostratus* (Girard).—San Francisco to Guadalupe Island. Many specimens taken from poisoned tide pool at Port San Bartolome.

11. *Enneapterygius carminalis* (Jordan and Gilbert).—West coast of Mexico north to Mazatlan. Two specimens taken with a glass jar at Cape San Lucas; many other examples seen here and at Espiritu Santo Island. Evermann and Marsh's *Gillias jordani*, from Porto Rico, agrees with E. *carminalis* in the generic characters which they used to separate *Gillias* from *Enneanectes* of Jordan and Evermann, according to Dr. G. S. Myers. Even if *Enneanectes* be withdrawn from the synonymy of *Enneapterygius*, *Gillias* must still remain a synonym of *Enneanectes*.

FISH COMMISSION OF OREGON, DEPARTMENT OF RESEARCH, PORTLAND, OREGON.

Observations on the Life-History and Breeding Habits of the Montana Grayling[1]

By C. J. D. Brown

THE Montana grayling (*Thymallus montanus*), like other species of the Thymallidae, breeds in the spring of the year. Milner (1874) gave April as the time of spawning for the Michigan species (*T. tricolor*), while Whitaker (1886) included March and April ("and perhaps even earlier"). Norris (1883) considered it to be a late spring spawner, referring to April and early May as the breeding period. According to von Siebold (1863: 270) the European grayling (*T. thymallus*) begins to spawn in March and may continue into April.

The actual period of spawning for the Montana grayling has been found to vary greatly between different years and between different localities in the same year. Whereas the controlling factors which initiate the breeding activity of this species have not been carefully studied, it is safe to say that the temperature of the water has great influence. In 1936 on Lower Odell Creek, tributary to Madison River, Montana, the first grayling came into the U. S. Bureau of Fisheries traps on March 15. The peak of the run was attained April 16 and the last individual observed appeared April 24. The same year a few spawners were taken in the Meadow Creek traps (a few miles downstream from the Odell Creek station) between May 1 and May 15. The spawning period seems to be much more concentrated in the artificially stocked lakes of the region. Experience has shown that grayling often run in advance of the rainbow and cutthroat trout and that the males frequently appear in advance of the females. At Grebe Lake, Yellowstone National Park, the run usually begins the day after the ice goes off. During the 5 years previous to 1937 the spawning period occurred at Grebe Lake between May 15 and June 20; at Rogers Lake, Flathead County, Montana, between May 1 and June 1; and at Georgetown Lake, Granite County, Montana, between May 10 and June 5. In these lakes the grayling run is much more concentrated than the trout run, usually lasting not over a week and often being confined to 2 or 3 days.

Henshall (1907) reported that the Montana grayling will travel long distances to find suitable spawning grounds. This is in contrast to published records for the Michigan species, which according to Norris (1883) does not migrate as do the trout. Bissel (1893) said of the Michigan grayling, " . . . they use the channel of the main stream not seeking the brooklets and shoals as trout usually do." Von Siebold (1893: 270) observed that the European grayling did not migrate during the breeding period. Certain observers, however, describe this species as running with the trout in English streams. There is no doubt that the Montana grayling migrates during the spawning period. Those in lakes move out into whatever streams are available and those in streams go varying distances depending upon the stream in question. Henshall

[1] Contribution from the Institute for Fisheries Research, Michigan Department of Conservation and University of Michigan. This paper reports one phase of researches on the Montana grayling, made with the aid of a grant from the National Research Council while the author was on the staff of the Montana State College.

(1907) had no evidence to support his contention, however, that the grayling he observed to use Red Rock Creek for spawning grounds came from the Jefferson River many miles below. More than likely most of these fish came from Beaverhead River and the Red Rock Lakes in the vicinity of Red Rock Creek.

No one has recorded evidence to show that either the Michigan or Montana grayling build nests. Heckel and Kner (1858), in describing the nest building process of the European grayling, stated that the nest is dug by means of the tail and that after the eggs are laid and fertilized the fish then cover the nest with small stones.

Dr. I. H. Treece described the breeding habits of the Montana species as follows: "Grayling are not particular where they spawn; that is they will spawn on a gravel bed or out in the weeds along shore where there is gravel. They pair off to spawn and I never saw any other fish spawn just as they do; the male and the female will get just as close together as you could place your two fingers and then both spawn at the same time. I do not believe they make any effort to cover the eggs with gravel as do trout; in fact I believe the most of the eggs hatch without any cover." (Quotation from Laird, 1929.)

On June 6, 1936, through the courtesy and help of Mr. A. G. Stubblefield, Superintendent of the Montana State Fish Hatchery at Anaconda, the writer had an opportunity to observe the spawning process of grayling congregated in the inlet creek to Agnes Lake, Beaverhead County, Montana. This small stream, flowing about 1½ cubic second feet, enters the lake from the west end and has its source in the not far distant snowbanks. Due to the location of a newly built beaver dam, only about 100 yards of the stream adjacent to the lake was available for spawning. The water was brownish in color and its temperature on June 6 was 10° C., which is rather warm considering elevation and the type of stream. Both the color and temperature of the water were no doubt influenced by the series of beaver ponds immediately upstream. The bottom of the creek was composed of sand and fine gravel at a ratio of about 3:1.

At the time we approached the stream there were between 100 and 200 fish in the available section. These were mostly congregated so that several pairs were together, with a scattering of odd males moving slowly at random in the stream. One of the larger groups was composed of 13 males and 8 females. The ratio of males to females for the entire section was about 3:2. Most of the fish were concentrated directly downstream from riffles, although several pairs were in the swiftest water of the riffles. We were surprised at the lack of fear exhibited by the fish, as this was quite in contrast to the reactions of trout under similar circumstances. After our first approach they seemed to ignore our presence completely, even though we moved slowly about. It was possible to stand in the stream only 2 or 3 feet from the fish and observe their spawning behavior somewhat in detail.

There was no indication that these grayling had built or were attempting to build nests. All of them seemed to move around at random, changing positions frequently.

A spawning pair on a swift riffle was closely watched, where the water, very clear and 8 to 10 inches deep, flowed over a perfectly smooth bottom

of coarse sand. After the male had come abreast of a female so that their bodies were 2 to 5 inches apart, and the fish had remained in this position for 2 or 3 minutes, the male moved nearer to the female until his body touched hers for much of their length. As he did so the huge dorsal fin was extended and arched so that it folded over her back. She then moved away quickly in an upstream direction, soon to be followed by the male, whereupon the original position of the pair was again established. This whole activity was repeated three times, with only one interruption when another male moved in directly behind the spawning pair. After several sideward motions of the body, the spawning male chased the intruder away but not with as much pugnacity as is usually exhibited by trout. The fourth time the spawning male approached the female she did not move as previously described, but seemed to crowd nearer to him so that their bodies were in direct contact from the head to the vent and at the same time the dorsal fin of the male was completely and tautly curved over her back. The fish at this moment were parallel with the current and as near abreast as one could have placed them.

Immediately upon contact, their bodies seemed to stiffen and then vibrate. The motion increased in intensity to a climax which was reached in 10 to 12 seconds. During the last part of this activity the tails of both fish approached the bottom so that their bodies were at an acute angle with it. As a result of this position and the vibration of their caudal fins, the sand beneath was greatly agitated and stirred momentarily into the lower water, making a depression 3 or 4 inches deep and decreasing the visibility so that it was impossible to see eggs or milt that might have been extruded.

A screen was placed directly behind the fish in an attempt to recover any eggs which might float downstream with the current. None appeared, however, and as the pair moved apart, sand was scooped up from both sides and from the bottom of the depression which was fast filling with sand from upstream. About 20 soft, newly laid eggs were found, no more in the pit of the depression than on either side. It was quite apparent that the very adhesive nature of the eggs had enabled them to become completely covered with the agitated sand grains and by means of this added weight be carried into the depression below, there to be at least partially covered and protected. The adhesiveness of the eggs may represent an adaptation to spawning in a current over sand or fine gravel, without a previously prepared nest.

Many water-hardened eggs, most of them of odd shape as compared to the round eggs kept under artificial conditions, were found in the sand over the spawning areas of this stream. The oldest embryos from these eggs had reached a stage similar to the 9-day-old individuals kept under hatchery conditions at a water temperature of 50° F. We secured no information regarding the further development of eggs deposited here.

Three other pairs of grayling were observed to spawn in this same stream. One female repeated the spawning act twice in 45 minutes, with two different males. It is probable that the egg laying interval for individual fish lasts about 2 to 4 days.

The spawning procedure itself should not have been greatly altered by the semi-artificial conditions afforded at Agnes Lake. However, there was no opportunity to test the selection which these fish might show as to the

type of stream and kind of stream bottom. The question still remains unanswered, therefore, as to what constitutes a natural spawning ground for this species. An attempt was made to locate the spawning grounds used by the grayling of the Madison River, but without success.

There has been considerable discussion among fish culturists as to the number of eggs produced by an individual female grayling. Whitaker (1886) recorded 3,555 eggs as having been produced by one Michigan grayling which weighed only 9 ounces after the eggs were removed. In a discussion of Mr. Whitaker's paper, a Mr. Clark mentioned having taken 25,000 eggs from 6 or 8 females, and 5,200 eggs from one fish that weighed 1¼ pounds.

According to reports, the Montana grayling trapped at Grebe Lake in 1935 averaged 1,650 eggs per female. One ¾-pound specimen taken from this lake had 5,563 eggs by actual count. Two ⅓-pound (2-year-old) fish taken at the same time contained 1,248 and 416 eggs respectively. Two grayling from the traps at Rogers Lake contained 9,059 and 4,904 eggs respectively, and 9 others from the same place, ranging in total length from 12¾ to 14½ inches and averaging 15 ounces in weight, showed a maximum of 7,068 and an average of 5,828 eggs per fish. Three large females from Georgetown Lake, averaging 2 pounds in weight, contained 12,946, 12,642 and 8,135 eggs respectively. In comparison with trout, grayling males produce very small quantities of milt. It is often difficult in artificial spawning operations to secure enough sperm to fertilize the eggs.

For many years fish culturists expected about a 40% mortality in grayling eggs during the period before hatching. According to Mr. Fred J. Foster of the U. S. Bureau of Fisheries, the mortality of the grayling hatched at Grebe Lake has not exceeded 10% in the past few years.

The interim between fertilization and hatching has been found to vary from 11 to 22 days depending upon the water temperature and certain other factors not understood. When the water temperature is 50° F., the average time is about 16 days with a variation of 7 days. The hatching process is ordinarily of short duration, lasting only a day or so.

Grayling fry, although considerably smaller than trout fry, grow much faster than the latter for the first year or so of life. Hatchery reared Montana grayling reached one inch in length at the end of the second month; 2½ inches at the end of the fifth month; and 7 inches at the end of a year.

Norris (1883) gave the age and length of the Michigan grayling as follows: first year 6 inches; 2nd year 10–12 inches; 3rd year 13–15 inches; 4th year 16–17 inches.

Creaser and Creaser (1935) computed the average total lengths of grayling from the Otter River in Michigan as follows: first year 4⅛ inches; second year 8⅛ inches; third year 10½ inches. They also gave computations made on the Montana grayling from Georgetown and Rogers lakes as follows: first year 4⅜ inches; second year 10⅜ inches; middle of third year 13¾ inches; middle of fifth year 15½ inches.

A considerable number of the Montana grayling spawn at the end of their second year. The majority of spawners taken at Grebe and Rogers lakes were in the 3 and 4 year classes as determined by scale studies, which will be reported in a later paper.

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Studies on the Genera of Cyprinodont Fishes. XIV. *Aplocheilichthys* and Its Relatives in Africa

By GEORGE S. MYERS

THE present contribution is the fourteenth of a series of papers (Myers 1924 to 1936) in which I have attempted to introduce some order into the exceedingly confused generic classification of the fishes of the order Cyprinodontes, or Microcyprini, particularly the oviparous groups. Since these papers are widely scattered in various journals, I believe it will be useful to fellow workers to list them.

The first two of these papers (1924a, 1924b) gave preliminary notes, a few of which subsequently proved to be ill-founded. The third (1924c) showed that the supposed Japanese cyprinodont *Fundulichthys* was mythical, having been based on the figure of a cyprinid. In the fourth (1925), besides diagnosing the remarkable genus and species *Trigonectes strigabundus* and presenting miscellaneous notes on American forms, I proposed that the Neo-

tropical genera clustering about *Rivulus* be recognized as a distinct group, or tribe (Rivulini). In the fifth (1927), the genera of this tribe were revised; additions to and emendations of this revision were introduced in the ninth (1932) and eleventh (1935a) papers of the series. In the sixth (1928a) I endeavored to show that the Phallostethidae, formerly considered to be cyprinodonts, are not members of the order. The seventh (1928b) relegated the sole European *Fundulus*-like species to a monotypic genus, *Valencia*, similar to *Profundulus* in its primitive features.[1]

The eighth paper (1931) was devoted to a delineation of the primary groups of the oviparous genera, and forms a key to the general classification adopted.[2] The tenth (1933) revised the Old World genera related to the American *Rivulus*. In the twelfth (1935b), I gave my views on the classification of the New and Old World genera of the subfamily Cyprinodontinae, and in the thirteenth (1936) I presented osteological and other notes on the subfamily Lamprichthyinae.

Of the oviparous cyprinodonts, there remain several groups not yet treated in detail. The Indo-Malayan tribe Oryziatini [3] contains but a single genus and will not be considered further in this series. Material is in hand for further supplementary notes on my 1927 revision of the *Rivulus*-like Neotropical genera, and for osteological work on the family Adrianichthyidae. Dr. Hubbs and I will shortly consider in some detail the strange oviparous South American genus *Tomeurus;* its unrelated but amazing counterpart in the Bombay Presidency will soon be announced by Mr. Kulkarni.

The present paper defines the genera of the African tribe Aplocheilichthyini as I delimited it in 1931. In the classification of the oviparous Cyprinodontidae it will be noted that I have placed much less reliance in the dentition than has Ahl (1924). Only in a few instances (*Lucania, Leptolucania, Chriopeops, Cubanichthys, Crenichthys*) do I feel that really good generic differences can be based on the form and arrangement of the teeth. Throughout the African Fundulinae the teeth of the forms I have seen are of one general type, with very minor modifications. There is usually a band of three or more rows of sharp, conical, slightly recurved teeth, often with the outer or inner series enlarged. The rows between the inner and outer series may be regular, or so irregularly placed that it is impossible to determine the number of rows. The form and size of the teeth of this fundamental pattern vary so much interspecifically, as well as individually, that their use as a prime classificatory character seems to lead more to confusion than to clarity. Moreover, it is possible that there are sexual differences in the dentition of a number of species. In dried specimens, or ones preserved in very strong spirits, the teeth appear to be much longer and more hooked than in well-preserved specimens. In contrast to the variability and difficulty of interpre-

[1] *Valencia* needs further study, for which I do not now have the material. Though apparently similar to *Profundulus*, it is probably not phylogenetically close to that Central American genus. The single species, *V. hispanica*, is confined to eastern Spain. *Fundulus letourneauxi* Sauvage, from Corfu, which I once thought to be a *Valencia*, seems to be an *Aphanius*.

[2] As have other writers, I utilized the conical teeth to distinguish the subfamily Fundulinae from the Cyprinodontinae, which have tricuspid teeth. Hubbs (1932) has recently described a funduline, *Crenichthys*, with bicuspid teeth.

[3] Dr. Hugh M. Smith will shortly show that the name *Aplocheilus* must be transferred to those species which I (1933) have called *Panchax*, and that *Oryzias* should be substituted for *latipes, melastigma*, and their allies. I introduce this note in order to point out that my tribe Rivulini (Myers 1931) becomes Aplocheilini and my Aplocheilini of 1931 becomes Oryziatini.

tation of the dentition, the structure of the mouth-parts and other organs leads to a classification which is undeniably in line with phylogenetic differentiation, even though the characters used may at first seem difficult to detect by those unfamiliar with the group.

In the Aplocheilichthyini there are three genera, based by Ahl on dental characters of single species, which I have not been able to examine. If the differences are as well-marked as he believes them to be, the genera are probably recognizable, but I suspect that two of these monotypic genera are based on species, which, if their total characters were considered, would be no more separable from the great mass of species of *Aplocheilichthys* than are many others now unhesitatingly referred to that genus. Beyond this, I am not one of those persons who believe that like modifications must always be given similar weight in classification. All of us know certain species or genera in which a given character is variable and others, perhaps closely related, in which it is constant. Yet even where a given character is constant in certain species of one group, and is there universally accepted as of generic value, in another the totality of characters may make its use as a generic character more artificial than natural. I feel strongly that this may be the case with the two monotypic genera mentioned, but not having seen the species on which they are based, I am forced to accept them, and to use dental characters extensively in the key.

Tribe APLOCHEILICHTHYINI

APLOCHEILICHTHYINI Myers, 1931: 11.

Premaxillaries protractile. Pectoral fins set high, the upper end of the fin base at middle of depth or above. Preorbital wide, usually half eye diameter or more. Vomerine teeth and pseudobranchiae absent. Dorsal fin origin behind that of anal in all known forms. Confined to the Ethiopian region and Nile.

There can be no doubt that the group of genera comprising this tribe form a closely inter-related and homogeneous unit. They are all very similar in anatomical features, in the usually pale coloration of alcohol specimens, in the rounded or truncate caudal, and in general appearance. Some aberrant species, such as *Aplocheilichthys pelagicus* Worthington, are rather elongate and atypical in appearance, and have the pectoral fins set lower than in most, but no one who has studied these little African fishes really carefully could possibly mistake one of them for a member of any of the other African groups, even on macroscopic examination. There is a difficult-to-describe but very real difference in the appearance of these pale little fishes and the dark colored (usually red spotted) West African species of *Aphyosemion*, the only other African genus with which most of the species could possibly be confused.

More likely to be questioned is the advisability of separating them as a group from the Aplocheilini (equals Rivulini; see footnote 3). In many of the small, slender and more specialized species of *Aplocheilichthys* the pectoral base is very little higher than in some species of the Aplocheilini, and the enlarged eye makes the preorbital appear relatively narrow. Furthermore, pseudobranchiae are sometimes absent in the Aplocheilini.

Those who believe that a classification or synopsis should enable a person unfamiliar with a group to place immediately a specimen in hand will doubtless object to the separation of these two tribes or even the generic segregation of certain species in one tribe from some in the other one. I freely admit that this is in some degree a valid objection, but there are other points which should be considered. Briefly, my reasons for separating the Aplocheilini and Aplocheilichthyini are as follows: Each tribe is composed of a large number of species which are undeniably closely inter-related. The Aplocheilini as a group are clearly characterized by a very peculiar, narrow preorbital, which, when well understood, cannot be confused with that of any member of the Aplocheilichthyini. The members of the Aplocheilini possess both pseudobranchiae and vomerine teeth, which no members of the Aplocheilichthyini ever have. The difference in the position of the pectoral base is so well marked in most of the species as to cause no confusion. Lastly, to anyone at all familiar with the two groups, the intangible general habitus and appearance of all the members of either tribe are so characteristic that it is possible on the most cursory examination to place a specimen in its proper tribe without examining *any* of the technical characters mentioned. I think that these reasons amply justify the classification followed.

Synopsis of the Genera of Aplocheilichthyini

1a. One or two of the branchiostegal rays of each side detached from the rest and projecting backward some distance from beneath the lower part of the opercle as a pointed process; pelvic fins placed anteriorly, under or almost under the base of the pectoral fins; body and peduncle deep and compressed; predorsal area flattened. .....1. *Procatopus* Boulenger

1b. None of the branchiostegal rays detached and projecting backward from beneath the opercle; origin of pelvic fins behind the base of the pectorals.

2a. Body deep and abdomen greatly compressed (at least in the males) but with a median series of scales along the edge; pelvic fins inserted but a short distance behind vertical of base of pectorals.

3a. Teeth in a band composed of several irregular rows, those of both the inner and the outer rows of both jaws enlarged and more widely spaced than the others; body deep, the caudal peduncle much more narrow..... .....2. *Hypsopanchax* Myers

3b. Teeth in a band composed of several irregular rows, some teeth in the outer row in each jaw enlarged canines. .....3. *Platypanchax* Ahl

2b. Body not excessively deep and the abdomen not sharply compressed; pelvic fins usually inserted more posteriorly.

4a. Teeth in each jaw in a more or less wide band, the first row of which is moderately enlarged; predorsal region flattened or rounded..... .....4. *Aplocheilichthys* Bleeker

4b. Teeth in each jaw in three isolated rows, those of the two inner ones moderately enlarged and recurved, those of the outer being extraordinarily large recurved canines .....5. *Cynopanchax* Ahl

4c. Upper jaw with a wide band of somewhat enlarged teeth set irregularly, the outer row slightly less enlarged; lower jaw with three rows of teeth, the two inner ones of large recurved teeth and the outer of still larger broadly-spaced canines; body compressed but not deep; predorsal area rounded..... .....6. *Plataplochilus* Ahl

1. *Procatopus* Boulenger

Procatopus Boulenger, Ann. Mag. Nat. Hist., (7) 14, 1904: 20 (genotype by monotypy *P. nototaenia* Boulenger).

One or two branchiostegal rays detached from the others and projecting

backward as a soft pointed process from beneath the lower part of the opercle. Body and peduncle compressed, deep. Pelvic fins under or almost under the pectoral base. Teeth in several irregular rows. Teeth of the outer and inner row in each jaw somewhat enlarged, those at the side of the lower jaw largest. Outer teeth set far out and visible when the mouth is closed. The maxillary, almost to its end, is closely bound down by the skin of the preorbital region. The exposed sections of the scales of the sides are regularly hexagonal, in the midbody series more than twice as deep as long. Dorsal with 6 to 11 rays, its origin behind that of the anal. Anal fin long, with 13 to 17 rays. Caudal subtruncate. Pelvic fins long, pointed, their bases contiguous and slightly connected by a membrane. Vertebrae 29 or 30. Air-bladder large, deep, the upper posterior end bluntly pointed and extending out through four enlarged haemal arches. Predorsal area flattened.

The projecting branchiostegal rays (not hitherto recognized as such), the thoracic pelvic fins, and the deep body and peduncle all set this genus widely apart from the others.

Procatopus appears to be confined to Cameroon. Four species are known. Species examined: *P. nototaenia* Boulenger. Species not seen: *P. similis* Ahl 1927, *P. aberrans* Ahl 1927, *P. abbreviatus* Pellegrin 1929.

2. *Hypsopanchax* Myers

Hypsopanchax Myers, 1924a: 41 (genotype by original designation *Haplochilus platysternus* Nichols and Griscom).

Body deep and very compressed, the preventral area rather sharp but not knife-like, with a narrow median series of scales and the scales of the row on each side partially bent over. Caudal peduncle much less than half as deep as body. No projecting branchiostegal rays. Teeth in each jaw a band of several irregular rows. Inner and outer row composed of enlarged teeth more widely spaced than those of the other rows. Maxillary, almost to its end, closely bound down to the skin of the preorbital region. Scales with their exposed section deep, hexagonal. Dorsal fin short, with 9 to 14 rays, its origin behind that of the anal. Anal long, with 14 to 21 rays. Pelvic fins rather small, not attenuated, set rather far forward, but not under the pectorals; the pelvic bases are contiguous but the fins are not joined. Caudal subtruncate. Air-bladder large, deep; posterior end truncated and not extending out into the caudal region. Predorsal region sharply rounded, without flattened area except immediately behind the head.

The very compressed body, the deep, flattened and sharp abdominal edge, and the shallow caudal peduncle distinguish this peculiar genus from *Aplocheilichthys* and its allies. It appears to differ from the more recently described *Platypanchax* only in the dentition. The pelvic fins are more anterior in their position than in most of the species of *Aplocheilichthys*. The three known species all possess a peculiar pattern of coloration consisting of narrow, curved, vertical, dark lines formed by dark areas on the scale borders or ends (see Myers, 1924b: 7, fig. 4).

As far as known, the genus is confined to Central Africa: the Congo, the Ogowe, and the vicinity of Lake Edward. Three species have been described. Species examined: *H. zebra* (Pellegrin) 1929, *H. platysternus* (Nichols and Griscom) 1917. Species not seen: *H. deprimozi* (Pellegrin) 1928.

3. *Platypanchax* Ahl

Platypanchax Ahl, 1928: 116 (genotype by original designation *Haplochilus modestus* Pappenheim).

I have not seen the single known species of this genus, *Platypanchax modestus* (Pappenheim) 1914 and I have not had access to its original description. My knowledge of the form is derived solely from Ahl's generic diagnosis. *Platypanchax* appears to differ from *Hypsopanchax* only in the dentition.

4. *Aplocheilichthys* Bleeker

Aplocheilichthys Bleeker, Natuurk. Verh. Holl. Matsch. Wetensch. Haarlem, (2) 18, 1863: 116 (genotype by original designation *A. typus* Bleeker equals *Poecilia spilauchena* Duméril).

Haplochilichthys Regan, Ann. Mag. Nat. Hist., (8) 7, 1911: 323 (emendation).

Micropanchax Myers, 1924a: 42 (genotype by original designation *Haplochilus schoelleri* Boulenger).

Lacustricola Myers, 1924a: 43 (genotype by original designation *Haplochilus pumilus* Boulenger).

Lacrusticola Ahl, 1928: 113 (error).

None of the branchiostegal rays separated from the rest and projecting out as a pointed process from beneath the opercle. Gill membranes more or less broadly united. Position of pelvic fins various, usually relatively far back, but in a few species (*A. hutereaui, A. baudoni, A. johnstonii* and others) approaching the thoracic position of those of *Procatopus*. Dorsal fin origin always behind that of the anal. Caudal fin rounded to truncate, never lyre-shaped or with elongated rays. Body in some species (*A. katangae*) little compressed, in others (*A. hutereaui, A. baudoni*) predorsal is rounded, with no flattened area except the top of the head. Coloration usually pale, entirely lacking the rich, dark brown color seen in most of the species of *Aphyosemion*. Teeth in several rows, those of the outer row only are enlarged. Maxillary bound down nearly to its end by the skin of the preorbital region. Air-bladder large, rather deep, and not projecting into the caudal region.

This large and varied genus includes some very unlike species. The genotype, *A. spilauchen,* is the largest species, adults reaching a total length of 60 mm. It is a rather deep-bodied, compressed form, with a deep caudal peduncle. Some other species, such as *A. cabindae,* are very similar. At the other end of the series are tiny, slender, little-compressed species with a shallow peduncle, such as *A. schoelleri, A. antinorii,* and *A. katangae*. Were there no connecting forms, these two groups might be considered distinct genera, but species such as *hutereaui, macrurus, macrophthalmus, pumilus,* and *dhonti* form a series which does not allow a line to be drawn.

Several years ago, the writer (Myers 1924a) erected the new genus *Micropanchax* for the species allied to *schoelleri* and the subgenus *Lacustricola* for *pumilus*. Further material showed that I was mistaken in the statement that these species had but a single row of teeth, as Ahl (1928: 113) has already pointed out. Holly (1930: 258–261) has synonymized this genus with *Panchax,* a hasty move which is entirely at variance with the characters of the fishes.

The genus ranges through tropical Africa, from the Nile and Guinea south to Angola and Zululand.

Species examined: *A. spilauchen* (Duméril), *A. cabindae** (Boulenger), *A. hutereaui** (Boulenger), *A. baudoni** (Myers) 1924, *A. pumilus** (Boulenger), *A. dhonti** (Boulenger) 1919, *A. macrurus** (Boulenger), *A. schoelleri* (Boulenger), *A. antinorii* (Vinciguerra), *A. moeruensis** (Boulenger), *A. macrophthalmus** Meinken 1932, *A. katangae** (Boulenger). Species not seen: *A. analis* Worthington 1932, *A. atripinna* (Pappenheim), *A. carlislei* (van der Horst) 1934, *A. chobensis* (Fowler) 1935, *A. flavipinnis* Meinken 1932, *A. fuelleborni* Ahl 1924, *A. gambiensis* (Svensson) 1933, *A. jeanneli* Pellegrin 1935, *A. johnstonii* (Günther), *A. kassenjiensis* Ahl 1924, *A. keilhacki* Ahl 1928, *A. kingi* (Boulenger), *A. kongoranensis* Ahl 1924, *A. loati* (Boulenger), *A. loemensis* (Pellegrin) 1924, *A. luluae* (Fowler) 1930, *A. micrurus* Ahl 1928, *A. myaposae* (Boulenger), *A. normani* Ahl 1928, *A. pelagicus* Worthington 1932, *A. pfefferi* Ahl 1924, *A. rudolfianus* Worthington 1932, *A. stuhlmanni* Ahl 1924, *A. tschiloangensis* Ahl 1928, *A. vanderbilti* Fowler 1936, *A. vitschumbaensis* Ahl 1924. In the above list, the starred (*) species are those of which I have seen type specimens, mostly through the courtesy of Dr. Schouteden of the Musée du Congo Belge. I have added the year to those species described since the appearance of Boulenger's catalogue of African fresh-water fishes.

Of the thirty-eight described forms, some are perhaps not valid. *A. baudoni* is very close to *A. hutereaui* and may be identical with it. It represents *hutereaui* in the Chad drainage. *A. luluae* is very close to *A. katangae*. Several of the names proposed by Ahl may prove to be synonyms. It should be remembered, however, that these tiny fishes have escaped most collectors, and that many good species doubtless still remain undiscovered.

5. *Cynopanchax* Ahl

Cynopanchax Ahl, 1928: 115 (genotype by original designation *Haplochilichthys bukobanus* Ahl).

Body moderately deep and strongly compressed. Dorsal short, with 10 or 11 rays, its origin over the middle of the anal fin base. Anal moderate, rays 15 or 16. Pelvics not advanced in position. Caudal base scaled. Teeth of each jaw in three rows, the outer row composed of extraordinarily enlarged recurved canines, the two inner rows of moderately enlarged recurved teeth.

This genus differs from *Aplocheilichthys* only in the dentition. The single known species is *Cynopanchax bukobanus* (Ahl) from Bukoba, N. W. Tanganyika Territory. I know the species only from Ahl's descriptions.

6. *Plataplochilus* Ahl

Plataplochilus Ahl, 1928: 116 (genotype by original designation *Haplochilichthys ngaensis* Ahl).

Body moderately elongate and compressed. Dorsal short, with 8 rays, its origin over the middle of the anal base. Anal rather long, rays 16 to 18. Pelvic fins not advanced in position. Caudal base scaleless. Predorsal area rounded, not flat. Upper jaw with a wide band of somewhat enlarged, irregularly arranged teeth, teeth of the outermost row smaller than the others. Lower jaw with three rows of teeth, those of the inner two rows are enlarged and recurved while the teeth of the outer row are still larger, widely-spaced canines.

This genus, like the last, differs from *Aplocheilichthys* only in the dentition. The single known species is *Plataplochilus ngaensis* (Ahl) from Attogondema, Nga R., Cameroon. I have not seen specimens. Holly (1930: 258, 261, fig. 6), who figures this species, attempts to separate it from his "*Panchax*," in which he includes *Aplocheilichthys*, by the rounded predorsal area. It should be pointed out that several species of *Aplocheilichthys* (*hutereaui, baudoni, katangae, schoelleri*) also lack a flattened predorsal area and are not to be distinguished from *Plataplochilus* by this character.

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Museum of Natural History, Stanford University, California.

Ichthyological Notes

FEEDING HABITS OF TROUT IN WATERS CARRYING A HEAVY POPULATION OF NATURALLY HACHED FRY.[1]—Investigators frequently have expressed the opinion that trout normally tend to prey upon those food organisms which are most readily available. Because good streams suitable for spawning or for nursery grounds ordinarily teem with newly hatched fry during the months of late winter and early spring, the charge has often been made that at such times larger trout take heavy toll of the fry through cannibalistic attacks.

A stream of this sort is Sweetwater Creek, a small tributary of the Pere Marquette River, in Lake County, Michigan. While on an inspection trip in late April, 1937, Dr. A. S. Hazzard, Director, Institute for Fisheries Research, and Mr. E. R. Kuhne, then Wildlife Technician, U. S. Forest Service, found trout fry there in very great abundance, in locations where large trout could have captured them with ease. In response to a suggestion by Dr. Hazzard, Mr. Kuhne made a small collection of trout on April 30, 1937, the stomachs of which were sent to me for examination. The series consisted of 14 brook trout (*Salvelinus fontinalis*) ranging in standard length from 87–186 mm., (average 160), and one brown trout (*Salmo trutta*), of standard length 151 mm. The latter is included with the others in the following tabulation since its stomach contents (four caddis larvae and one mayfly nymph) are very similar to those of the brook trout. The contents of the 15 stomachs are as follows:

Organism	No. of Fish Containing Organism	Av. No. Organisms in Stomachs Containing Them	Percent of Total Volume
Trichoptera (larvae, 6 families)	15	5.7	37.3
Diptera (chiefly midge pupae)	12	9.8	15.0
Fish (*Cottus* sp.)	2	1.0	9.8
Amphipoda	10	2.2	8.0
Collembola	1	1500+	8.0
Plecoptera (nymphs and adults)	6	2.5	5.7
Insect Debris	2	x	4.6
Annelida	1	1.0	4.0
Mollusca (*Physa* sp.)	3	1.0	3.5
Ephemeroptera (nymphs)	8	3.0	2.0
Coleoptera (adult Hydrophilidae)	2	1.5	1.6
Hymenoptera	3	1.0	0.5
Hydracarina	2	1.0	trace
Homoptera (Cicadellidae)	2	1.0	trace

In none of the stomachs did any trace of trout fry appear, yet the two *Cottus* taken show that invertebrates were not given exclusive preference. Although a larger number of stomachs would have been desirable, these notes are offered in the hope of shedding some light on a question of considerable interest in fisheries management.—J. W. LEONARD, *Institute for Fisheries Research, University Museums, Ann Arbor, Michigan.*

ON *CARANX MATE LUDINI* (JORDAN AND SEALE).—On recent trips Mr. W. J. Morden has obtained an excellent series of this form from the Hawaiian Islands. It is very likely specifically distinct from *Caranx mate* Cuvier and Valenciennes (*Caranx affinis* Rüppell), but until it has been obtained from as far west as the East Indian region it may be considered at least a geographic representative of that species (Nichols, Amer. Mus. Novitates, 50, 1922: 1). Most references to *Caranx mate, C. affinis* and *C. kalla* from the central Pacific probably refer to it. I myself have recently confused it (in lit.) with the Indian fish referred to *C. kalla,* with which it may often be identified, but it is less deep than *kalla,* with lower, longer arch in the lateral line. It has the elongate form of *Caranx mate,* the numerous long gillrakers, conspicuous soft dorsal and anal sheathes, and enlarged, partially separated last ray of the dorsal and anal fins. A specimen from the Philippines in the University of Michigan Museum of Zoology (No. 100232, collected by Herre) is a typical *Caranx mate,* not distinguishable from 2 from Somaliland in the American Museum (No. 7745, collected by Barnum Brown). The standard lengths of the 3 range from 178 to 185 mm.; body width in head, 1.5 to 1.6,—considerably less compressed than *lundini.*

Caranx mate lundini is remarkably constant in body proportions at varying sizes. Of 23 specimens from the Hawaiian Islands, 4 from 101 to 116 mm. standard length have

[1] Contribution from the Institute for Fisheries Research, Michigan Department of Conservation and the University of Michigan.

depth in same of 3.3 to 3.4 (average 3.36), 9 measuring 117 to 126 mm. have depth of 3.4 to 3.6 (average 3.52), 10 specimens of 128 to 205 mm. have depth of 3.4 to 3.5 (average 3.45). Body width in head is 2 in 21 examples, 1.9 in 2.

Fifteen specimens 31 to 58 mm. in standard length, collected from under large jellyfishes in Pearl Harbor in March (by Mr. T. A. Cooke of Honolulu), are only slightly deeper, 6 measuring 31 to 41 mm. with depth of 2.7 to 3 (average 2.82), 9 from 44 to 58 mm. with depth of 3 to 3.1 (average 3.02).

In color these little ones as noted when received a short time after preservation were much like the larger individuals, which are silvery below and on sides of head, dark on the back; sides with faint dark cross-bars about as wide as the interspaces, which are most distinct on the mid-line of sides; a sharp black opercular spot; chin dusky, fins pale and unmarked. The young were silvery below blending to grayish olive above, with about 10 indistinct vertical darker olive bars across the back between head and dorsal axil which, in general, were narrower than the interspaces; a dusky opercular spot; chin more or less dusky; fins in general pale; caudal more or less grayish.—J. T. NICHOLS, *American Museum, New York City.*

FURTHER NOTES ON THE EGGS OF *RAJA EGLANTERIA* BOSC.—The eggs of *Raja eglanteria* Bosc were described by Breder and Nichols (COPEIA, 3, 1937: 181–184) from examples deposited by a female brought to the New York Aquarium from Sandy Hook Bay on June 14, 1934. These were compared with the eggs of other species of the

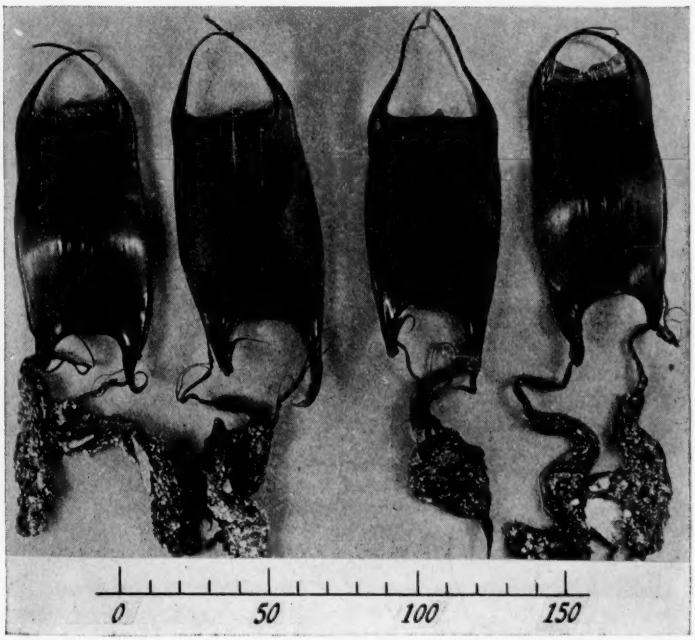

Fig. 1. Living eggs of *Raja eglanteria*. For comparison with the figure on page 183 of COPEIA, 1937 (3). Scale in millimeters. Photo by S. C. Dunton.

New York region. A remarkable feature was that each egg had a transverse slot near one end. Breder and Nichols wrote: "When the eggs were new this area was occupied by a transparent area of very thin and delicate shell which subsequently sloughed away to form a slot. In six cases identified with these, in the American Museum collection, this

slot was not evident." It was thought at the time that the drying of the latter egg cases might have had something to do with the inability to find such a slot.

On May 27, 1938, two large females were brought to the Aquarium from the same locality. They deposited three eggs the next day and three more the day following. On June 3 two more females were placed in the tank and eleven more eggs were subsequently discovered up to and including June 13. Two days later more females were added and three more eggs were found the following day, making a total of 20 eggs. None of these showed any evidence of the slot previously described. Figure 1 shows four of the new eggs, all of which are positively identified as the product of *Raja eglanteria*.

It thus appears that the slot may or may not be present or was, perhaps, a distinct abnormality reflecting merely some defect in the shell gland of a single female. This observation in no way changes the key of Breder and Nichols as that was not based on the presence or absence of the slot. Their other remarks concerning methods of anchorage and related matters are in accord with the present material. Moreover, the dimensions of the eggs laid in 1938 exceed the limits of variability given in the key of Breder and Nichols in but one instance. One egg case was 40 mm. wide, as opposed to 1⅝ inches (= 42.4 mm.), the minimum of the key. This, however, does not interfere with the separation of *R. eglanteria* and *R. laevis* since the latter is the larger.

SIZES AND PROPORTIONS OF THE EGGS OF *Raja eglanteria*

Length [1]	Width [1]	Length / Width	Length [1]	Width [1]	Length / Width
1934 eggs (with terminal slot)			69	40	1.7+
89	53	1.7—	68	48	1.4+
89	47	1.9—	67	50	1.3+
76	53	1.4+	67	47	1.4+
74	56	1.3+	64	46	1.4—
1938 eggs (without terminal slot)			63	48	1.3+
77	53	1.5—	63	47	1.3+
76	54	1.4+	63	43	1.5—
73	50	1.5—	63	42	1.5
72	47	1.5+	62	47	1.3+
72	45	1.6	61	43	1.4+
71	50	1.4+		Average	
69	50	1.4—	70+	48+	1.4+
69	49	1.4+			
69	48	1.4+			

It will be noted from the table that with two exceptions the 1934 eggs were all slightly larger than those of the 1938 series. There is a general trend for these eggs to become more nearly square as they decrease in size; that is, the width does not decrease as rapidly as the length in a series arranged from large to small. This seems to be but a reflection of the fact that the eggs vary more in length (61–89 mm.) than in width (40–56 mm.). Reducing the maximum value of the length and the width to unity, the least length is 69%, whereas the least width is 71%.

Since the eggs naturally pass through the oviduct with their long axes parallel to the wall of the tube—the four prongs, if nothing else, making this necessary, there is probably much greater restriction on variability of the transverse dimension of the eggs than of the longitudinal. This restriction would seem to apply all the way from the shell gland to the external opening.

Unfortunately the size of the 1934 skate was not recorded, but the spring run of skates from Sandy Hook Bay has always been of very nearly one size. Five of the 1938 females had a total length of 80, 79, 78, 77 and 67 cm.—C. M. BREDER, JR., and J. W. ATZ, *New York Aquarium, New York City.*

ALECTIS CRINITUS, A FISH NEW TO MASSACHUSETTS BAY.—The well-known threadfish or cobblerfish *Alectis crinitus* (Mitchill) ranges from the West Indies to southern Massachusetts, and is taken nearly every year on the southern coast of Cape Cod. The species has not been previously reported to the north and east of Cape Cod; but on September 1, 1937, a specimen 8.5 cm. long was captured in a trap at Sagamore, Massachusetts, on Massachusetts Bay north of the eastern end of the Cape Cod Canal. The fish was taken alive to Woods Hole and kept for a while in the aquarium at the United States Fisheries Station.

The possibility, if not the probability, that this example passed to the north side

[1] Measurements in mm.

of Cape Cod through the Cape Cod Canal is to be considered.

This species was described from Block Island, Rhode Island, in 1826 under the name *Zeus crinitus*. In citing the original description, Jordan, Evermann, and Clark (Check List of Fishes, 1930) give "Shoreham, Mass." as the type locality. There is no Shoreham in Massachusetts. New Shoreham is the Rhode Island township which embraces Block Island.

In separating the strictly Atlantic species *Alectis crinitus* from the East Indian form called *Zeus ciliaris* by Bloch in 1788, and *Carangoides blepharis* and *C. gallichthys* by Bleeker in 1852, Jordan, Evermann, and Clark (*l.c.*) place Bleeker's names in the synonymy of *Alectis crinitus*, a course which seems highly inconsistent.—HUGH M. SMITH, *Washington, D. C.*

RECORD OF THE FRESH-WATER MINNOW *APOCOPE NEVADENSIS* FROM SOUTHEASTERN CALIFORNIA.—

LOCALITIES OF COLLECTION.—The discovery in June, 1937, of *Apocope nevadensis* in a warm spring about a quarter of a mile north of Tecopa, Inyo County, and in the Amargosa River near Acme, San Bernardino County, adds to the known list of California cyprinids and extends the known range of this species. Each of these localities falls within the Amargosa Valley, just east of the southern part of Death Valley.

DISTRIBUTION.—This species was first described by Gilbert (1893: 230–231) from Ash Meadows, Nevada; a similar if not identical species is reported to occur at Beatty, Nevada (Myers, *in litt.*). During periods of flood, as observed in December, 1936, and January, 1937, the various populations may become intermixed in the drainage system; it is possible that some are washed into Death Valley and perish there as the waters recede. Saratoga Springs, in the southeastern arm of Death Valley, are not available to them, having no direct connection with the Amargosa River even during such periods. With regard to the isolation of these fish, which normally occurs, Dr. Elliot Blackwelder, of Stanford University, says, "It would not require a large climatic change to connect the various Amargosa springs in an integrated river system. There was such a river in late Pleistocene time,—twenty thousand years ago, more or less. There may have been such a river a few centuries ago. It seems on the other hand improbable that the Amargosa and Salt Creek systems (Saratoga Springs in the latter) have been connected by habitable water since the close of the Pleistocene." (Wales, 1930: 61.)

DIAGNOSTIC CHARACTERS.—A small minnow (56 mm. greatest standard length recorded) with large head and short, deep body; scales small and irregularly arranged, and lateral line incomplete in adults; eye small. A distinct dark lateral stripe present between base of operculum and caudal; this becomes progressively darker posteriorly and ends in a black spot at base of caudal. Fins small; body finely speckled. D. 8; A. 7; V. 7, outer ray often rudimentary. Total number examined, 21.

ASSOCIATED FISH FAUNA.—In the Amargosa system, *Apocope nevadensis* is frequently found in association with the desert killifish, *Cyprinodon macularius*. This association is conspicuous in the Ash Meadows district and it also occurs at Tecopa and in the Amargosa River, when this "river" has a surface flow. From Beatty only the cyprinid is reported. The cyprinodont far outnumbers the former in nearly all localities observed; however, at Fairbank Spring, at the north end of Ash Meadows, the minnow appears to be the more numerous.

LOCATION OF PRESERVED MATERIAL.—A series of 21 specimens from a Tecopa warm spring in the Stanford University collection.

ACKNOWLEDGMENT.—I wish to express my thanks to Dr. Carl L. Hubbs, Curator of Fishes at the University of Michigan, for his check upon the identification of the Tecopa specimens.

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ROBERT R. MILLER, *Museum of Vertebrate Zoology, University of California, Berkeley, California.*

Herpetological Notes

RANA BOYLII IN OREGON.—The California yellow-legged frog (*Rana boylii boylii*) has hitherto been recorded in Oregon only in the southwestern part of the state. Drain, Douglas County, in the Umpqua River drainage, is the northernmost record (Slevin, 1930, Occ. Pap. Calif. Acad. Sci., 16: 138).

Material recently collected demonstrates that the species ranges north along the west flank of the Cascade Range into the Willamette River drainage in the northwestern part of the state. On June 18, 1935, specimens were collected at Rolling Riffle Creek on the middle fork of the Willamette River, Lane County, and I have seen these frogs at the mouth of the McKenzie River near Eugene. On October 13, 1937, several were collected along a deep, slow-moving creek near Mehama, Marion County, in the Santiam River drainage, in woods of broadleaf maple, alder, and Douglas fir. Red-legged frogs (*Rana aurora aurora*) were much more abundant at this locality and many were found in the wet herbaceous vegetation, some at a distance from the edge of the creek. However, all yellow-legged frogs found were within two small areas, each only a few yards square, where the creek was swifter than usual and there were rocks along shore and others protruding above the surface in the stream; all *boylii* seen were on these rocks.

A probable limiting factor in the northward distribution of this species is the general lack in northwestern Oregon of streams with open, gravelly margins. Edges of the prevailingly deep, slow-moving streams, with undercut banks, and dense riparian growth which often overhangs the water, do not furnish the rocky habitat which ordinarily seems to be an ecologic requirement of the yellow-legged frog.

I have two locality records in southwestern Oregon, east of the Cascade divide. One of these is of a specimen (Mus. Vert. Zool.) taken at the Klamath River 13 miles from the California state line. The other is at Lake of the Woods, at about 5000 feet altitude and near the crest of the Cascades but draining eastward into Klamath Lake. At this locality the frogs were abundant in meadows along the edge of a creek, where there were no rocky banks. The habitat there was even less typical in that the life zone was Canadian, as indicated by dominance of lodgepole pine and snow brush (*Ceanothus velutinus*). Farther eastward, at lower altitudes in the Klamath Lakes basin, yellow-legged frogs seemingly do not occur, but there is no physiographic barrier and it is possible that the increasing aridity is the excluding factor there.

In the Rogue River basin of southwestern Oregon, where the species is extremely common under suitable habitat conditions, a colony of only a few individuals is known to have persisted several years, six miles south of Medford in a deep gully near the head of a small tributary creek, which, in summer, goes dry for its entire course. At this place the creek bottom is silty, without rocks, and there is no riparian vegetation; but a small pool of water, or at least wet mud, remains in the bottom of the gully all summer, and the high banks provide shade. Possibly lack here of certain favorable features usually present in *Rana boylii* habitat is more than compensated for by the absence of several predatory species, turtles, garter snakes, bitterns, and herons, which are common along the larger and more permanent streams of the region.—HENRY S. FITCH, *Museum of Vertebrate Zoology, Berkeley, California.*

AN OLDER NAME FOR *TRITURUS SIMILANS* TWITTY.—The species of newt to which the specific name *similans* was recently applied by Twitty (1935, COPEIA: 76) ranges far north of the type locality, near Ukiah, Mendocino County, California. Apparently the closely related species *Triturus torosus* and *Triturus rivularis* are exclusively Californian. All newts from extreme northern California and from Oregon differ from both these species and agree with *similans* in their diagnostic characters—palatine teeth arranged in V-shaped pattern; orange rather than red ventral color; broad heads in breeding males; yellowish eyes; lips of cloaca forming a conical elevation in breeding females; larvae dotted, not striped, and with broad fins; eggs deposited singly (by captive individuals); breeding season late. Mr. Thomas L. Rodgers, who has identified all the *Triturus* material in the Museum of Vertebrate Zoology, using Twitty's diagnostic characters, corroborates my identification of all Oregon specimens as *similans*.

On collecting trips through western Oregon I have purposely collected *Triturus* in diverse ecologic situations with the idea of ascertaining whether more than one kind occurs there. There are now in the Museum of Vertebrate Zoology 67 of these Oregon *Triturus* from 13 different localities in Multnomah, Yamhill, Clackamas, Marion, Lincoln, Linn, Klamath, Curry and Jackson counties. Evidently none occurs in the arid region east of the Cascade Range in Oregon.

Skilton (1849, Amer. Jour. Sci. Arts, (2) 7: 202, pl. 1) described a newt from Oregon as *Salamandra* (*Triton*) *granulosa*. This name has generally been considered a synonym of *Triturus torosus*, since the brief description mentions no characters which could not pertain to that species. The type was described as "reddish brown above, orange beneath," was coarsely granular, and was found on land. Further information is supplied to the effect that it was brought from Oregon by the Reverend George Gary, superintendent of Methodist Missions in Oregon.

Another new species also collected by Gary was described in the same paper as *Tropidolepis scincicauda* (*Gerrhonotus multi-carinatus scincicauda*) and was stated to occur in the region about The Dalles. It is improbable that the type of *granulosa* was also collected at The Dalles, as this locality is in arid country east of the Cascade Range, with a flora and fauna composed chiefly of Great Basin species. No newts have since been recorded from near The Dalles and I did not find any in several days' collecting there during July, 1932. However, *Triturus* may possibly extend this far eastward in the Columbia River gap through the Cascade Range, as many other plant and animal species characteristic of the Pacific Coast region do.

Gary, the collector of the type, came to Oregon by boat from New York *via* the Hawaiian Islands and the Columbia River; he returned home by the same route, having visited no points on the Pacific Coast outside of northwestern Oregon. As indicated by his diary (Carey, 1923, Quart. Oregon Hist. Soc., 24: 68 ff) the entire period of his stay in Oregon, from June, 1844, to July, 1847, was spent in the lower Willamette Valley in the vicinity of "Willamette Falls" (Oregon City) except for two visits to The Dalles where he stayed from September 6 to 23, 1844, and from April 14 to July 21, 1846. It seems reasonable to assume that Oregon City is the type locality of *granulosa*, since *Triturus* is abundant in this general region.

I have no information regarding the fate of the type specimen. That the description may have been based on two or more specimens is indicated by the statement, "Cabinet of A. J. Skilton, and of the Troy Lyceum of Natural History." Since the region where Gary collected in Oregon is inhabited by newts of the *similans* type and no others, *Triturus granulosus* (Skilton) should take precedence over *Triturus similans* Twitty.—HENRY S. FITCH, *Museum of Vertebrate Zoology, Berkeley, California.*

ADDITIONS TO THE HERPETOFAUNA OF MEXICO.—Through the courtesy of Dr. Leonhard Stejneger and Dr. Doris Cochran, I have been enabled to examine certain specimens in the National Museum, and to report four which represent three species previously unknown from Mexico. I am indebted to Dr. Edward H. Taylor and Dr. Howard K. Gloyd for part of the data on these specimens. Mr. M. Graham Netting has kindly permitted me to include data on a specimen of *Tantilla kirnia* in the Carnegie Museum.

Crotaphytus reticulatus Baird

A single specimen in the National Museum (No. 47707) was collected by William Lloyd in 1891 at Mier, Tamaulipas. It is a young female measuring 69 mm. snout to vent; the interorbitals are in two rows; the dorsal coloration is typical, consisting of numerous, rounded, dark-edged, brown spots.

It is remarkable that this species has such an apparently limited distribution compared with other mainland species of the genus, and that it should remain relatively so scarce in collections. Six specimens in the Kansas University collection enlarge the concept of its range. The following localities are represented: Eagle Pass, Maverick Co., and Ringgold Barracks, Arroyo El Tigre, Rio Grande City, San Ignacio and 23 miles northwest of Rio Grande City, Starr Co. In 1932 Dr. Edward H. Taylor and I secured four specimens at Arroyo Los Olmos and Arroyo Salado, Starr Co. These were observed near pack rat nests, from which they were routed by flood waters. We found them extremely wary and difficult to approach.

Elaphe bairdii (Yarrow)

One specimen (USNM No. 103692) was collected in Carbonero Canyon, Carmen Mts., Coahuila, by R. S. Sturgis, on September 23, 1937. It was found under a log in a pine and oak wooded canyon. The scutellation is as follows: scale rows 25–27–19; ventrals 241; caudals 98; supralabials 8–9; infralabials 13–14; oculars 1–2; temporals 2–4–5; total length, 845 mm.; tail length, 180 mm. The following color notes were taken by Dr. H. K. Gloyd: Ground color bluish-gray above; lower labials, chin and throat cream; belly cream with grayish-brown, squarish blotches about one scale wide along sides, and stippling and flecking of same color along middle, all becoming more dense posteriorly; midventral line of tail pinkish; spots of dorsal pattern very indistinct; pattern of four longitudinal stripes: one on each side of midline, two scales wide, and one, less distinct, slightly lower on each side, all extending faintly on tail. Head bluish-gray, with no distinguishable pattern; supralabials cream, clouded with gray.

This species resembles *quadrivittata* in the development of a striped pattern in adults from a spotted condition in the young. The young are distinguished by the number of dorsal blotches, less than 50 occurring in *quadrivittata* and more than this number in *bairdii*. The adults may be distinguished by the position of the lateral stripes on the middle of the body; in *quadrivittata* they extend to the second scale row, while in *bairdii* they extend no lower on the sides than the third scale row.

Specimens of *bairdii* of intermediate size may be more or less uniform bluish-gray, resembling *chlorosoma*, from which it differs in number of scale rows (31 to 37 in *chlorosoma*, 27 in *bairdii*). From *Elaphe obsoleta* the species differs in subcaudal count (92 to 103 in seven males, 85 to 95 in three females of *bairdii;* usually less in *obsoleta*), in the number of dorsal blotches, when present (*obsoleta* has approximately the same number as *quadrivittata*), and in the presence in adults of a striped pattern.

Tantilla nigriceps kirnia Blanchard

Dr. E. H. Taylor has very kindly turned over to me data on two large specimens of *Tantilla* (USNM Nos. 46584–5) from Mier, Tamaulipas. His notes, which follow in quotation, indicate that the specimens belong to the recently described species *kirnia:* "No. 46585. Female. Head black, the color forming a blunt angle about two scale rows behind parietals; labials bordering eye and upper edge of seventh labial with some brownish pigment; fifth and sixth labials and lower part of first temporal not pigmented. Scutellation agrees closely with my figure (Trans. Kans. Acad. Sci., 39, 1937: 342, fig. 3), except the upper part of the nasal is not divided, the first lower labials are in contact, and the fifth supralabial does not touch upper postocular; ventrals 150, caudals 44. No. 46584. Female. Color identical with the preceding; scutellation similar to figure, except first lower labials are in contact; ventrals 146, caudals 39."

The minimum ventral count of *nigriceps* females is 150 (cf. Blanchard, Snakes of the genus *Tantilla* in the United States, Zool. Ser. Field Mus. Nat. Hist., 20: 376), while the single female *kirnia* seen by Blanchard (*op. cit.*) has 141.[1] The range in ventral counts of females of *kirnia,* based on the three specimens, is 141 to 150, while that of caudal counts is 39 to 44. While it is not at present known that the ventral counts of males of *nigriceps* and *kirnia* overlap, there is a complete overlap in caudal counts of both sexes, and the ventral counts of females of the two species overlap at least on the count of 150. Since *kirnia* is defined solely on the basis of ventral count, which shows some overlap with *nigriceps,* and since the two forms have adjacent ranges suggestive of subspecific relationship, it appears to me that they should be regarded as subspecies.—Hobart M. Smith, *Field Museum of Natural History, Chicago, Illinois.*

[1] A topotypic specimen of *kirnia* in the Carnegie Museum (No. 8454, 9 miles east of Pleasanton, Atascosa Co., Texas) is also a male. The counts are typical, 133 ventrals and 43 caudals.

Reviews and Comments

THE IMPROVEMENT OF LAKES FOR FISHING, A METHOD OF FISH MANAGEMENT. By Carl L. Hubbs and R. W. Eschmyer. Lansing, Michigan, May, 1938. 1–233, 74 figs. $1.25 (paper) or $1.75 (cloth binding).—In this book, Bulletin No. 2 of the Institute for Fisheries Research, the authors present *Method of Fish Management* for lakes to accompany that widely used and valuable guide *Methods for the Improvement of Michigan Trout Streams.* But this book is more than a companion piece to that notably useful publication. It derives special importance as an initial bulletin on the improvement of lakes and combines the serviceable features of a handbook and text on the management of lake conditions.

Cognizant of the increasing public drain on the fish supply and critical of the adequacy of prevailing practices, the authors, in the introductory chapter, emphasize the importance of the method of *Environmental Control* as applied to the increased production of lake fish and its place as an integral part in the fish management program along with artificial propagation and restrictive regulation. In this connection, it is pertinent to quote the following paragraph under Definition and Need:

> Lake improvement as the term is used in this bulletin, signifies the creation and maintenance in our lakes of conditions which favor the propagation, growth and yields of inland lake fish. It is based on the premises (1) that either in their natural or their present condition, our inland lakes differ greatly in the quality and yield of the fish which they produce; (2) that fishes require more than pure water in which to survive, grow, multiply and become available for harvest; (3) that such essential conditions in lakes as shelter, food and spawning facilities are often so deficient as to limit the fish production; (4) that it is possible to identify such limiting factors, and (5) that it is often practicable to increase the crop of lake fish through the deliberate and skillful adjustment of the environmental factors.

Because it requires experience to say what is tried and proven, the urgent need from a management point of view is for more information, experiment and research to devise effective methods for studying diverse types of lakes. Special needs are stressed for more biological information, for checking results, for more trained men and for publication of improved methods in this and allied fields that are fundamental in fish management.

Important chapters center attention on *Meeting the Requirements of Lake Fishes* and on *Planning and Carrying out the Work.* Here the authors have culled out of a background of facts only those that have real pertinence. A chapter on: *What to do if—*, gives numerous directions following diagnosis. In some cases, the course to pursue is mainly theoretical and probably would be impracticable in many situations so that when tried and checked the answer might be that nothing could be done under the particular circumstances. Doubtless, the authors are aware of this and mean only to stimulate the need for action.

Under the heading of *Methods of Improving Conditions for Lake Fishes,* the desirable improvements in environment are dealt with in detail. Among the discussions under this heading are: Improving the Shelter; Managing the Plant Growth; Bettering the Spawning Conditions; Regulating the Abundance of Fish; Increasing the Natural Food; Preventing Erosion and Silting. These and other topics give this chapter a special appeal and timeliness. Supporting the text are many unusually clear photographs and drawings of devices suggestive of the materials to use and the steps to take in their construction.

A chapter on *Improvement of Artificial Lakes* (under the authorship of Walter W. Aitken and J. Clark Salyer II) rounds out the subject of methods in a field of activity of growing interest. A number of excellent photographs and drawings present effective aids in the construction of suitable devices for spawning, shelter and the increase of the food supply.

In the final chapter, the practicability of lake improvement and its place in fish management, are convincingly set forth. The stimulating discussion of objectives sharply defines the need of broad operations in fish management such as are now given to the production of agricultural crops.

No other volume on this subject has appeared, and for that reason alone this book is of exceptional value and timeliness.—Emmeline Moore, *New York Department of Conservation, Albany, New York.*

ATLANTIC SALMON FISHING. By Charles Phair. Derrydale Press, New York, 1937: i–xx, 1–182, 102 figs., several colored plates. $25.00.—I opened this book with a certain amount of prejudice. After reading a number of books by anglers, I have about concluded that any man strong enough to hold a rod *and* a pen is not satisfied until he has written a book describing his emotions while fishing. Very dreary reading it often turns out to be, too.

Mr. Phair's book is not in this class, however. It is readable, calm, and full of practical information on the technique of angling. The chapter on salmon fly dressing is particularly fine and well illustrated. The chapters on life history and on protecting and stocking salmon rivers is a job well done for the scope of this book; nevertheless, there is a good deal more information in scientific literature which could well have been included to make something approaching a "complete" book on the Atlantic salmon.

Mr. Phair talks mostly about privately owned or leased streams. He says, "Personally I am not in favor of free salmon fishing. It generally is poor, for such rivers are overfished; and to give the best results salmon water must be fished with some discretion. Furthermore, such streams are soon depleted, since they do not get as good protection from the Government as they would from private individuals." *There* is something for conservationists to mull over.

The price of the book is against it; but when you consider that salmon fishermen of the kind Mr. Phair writes of and for pay $1,000 up to $10,000 for their share in a fishing club, and spend sums like $60.00 on half a dozen flies, a mere $25.00 seems trifling. Besides, though the book seems to me considerably less satisfying in format than some of the other Derrydale productions, it is, nevertheless, a collector's piece, and a beautiful addition to any library.—Lionel A. Walford, *U. S. Bureau of Fisheries, Stanford University, California.*

TROPICAL AQUARIUMS, PLANTS AND FISHES. By A. Laurence Wells. 160 pp., 62 text figures, 1 colored frontispiece. Frederick Warne & Co., Ltd., London and New York. 1937.—This is a useful and informative little manual of tropical aquarium keeping. The general sections are good, but omit mention of the important fact that tropical fishes jump out of tanks and must be restrained by a cover. Some scientific names are misspelled (for example, *Kryptopterus*). The remarkable fish distribution maps on the linings show paradise fish in the China Sea, *Mollienisia latipinna* taking off from San Diego, a Malayan gourami perched atop Mt. Everest, and, last but not least, a solitary *Hemigrammus unilineatus* exiled (like Alexander Selkirk) on Juan Fernandez!—George S. Myers, *Natural History Museum, Stanford University, California*.

MODERN COARSE FISHING. By H. D. Turing. A. and C. Black, Ltd., London, 1937: i–xi, 1–240, 8 pls., 11 figs. in text. $2.50.—Mr. Turing classes as "coarse" all fresh water fishes of the British Isles except salmon and trout, and puts up a gallant defense for the game qualities of these too-often deprecated species.

He describes the fishing rather than the fish, classifying it into three divisions: slow-flowing rivers, swift rivers, and still waters such as lakes, ponds and canals. He has a chapter on "spinning," which in plain American, is casting; and also a chapter on "spinning American style." His comparison between English and American casting is, of course, from the English viewpoint, and few Americans could be found to agree with him. There is an excellent chapter on fishermen's knots.—Talbott Denmead, *United States Bureau of Fisheries, Washington, D. C.*

Recent Books Received

Fish Passes in Connection with Obstructions in Salmon Rivers *being* the Buckland Lectures for 1937. By T. E. Pryce-Tannatt. Edward Arnold & Co., London, 1938: 1–108, 32 figs.

Scientific Illustration. By John L. Ridgeway. Stanford University Press, Stanford University, California, 1938: i–xiv, 1–165, 23 figs., 22 plates, colored frontispiece.

The Reptiles of Ohio. By Roger Conant. The American Midland Naturalist, 20 (1), July, 1938: 1–200, 26 plates, 38 maps. To be reviewed in next issue.

EDITORIAL NOTES AND NEWS

Summary of the 1938 Meeting

THE twenty-first annual meeting of the AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS was held in Berkeley, California, from Tuesday evening, July 19, to Saturday, July 23. A dinner meeting of the BOARD OF GOVERNORS was held in the Hotel Durant at 6:15 P.M., July 19, with VICE-PRESIDENT KLAUBER presiding. Matters of business were discussed and the incoming president was empowered to appoint a number of necessary committees. Formal action taken included the election of SIR ARTHUR SMITH WOODWARD, MAJOR STANLEY S. FLOWER, DR. C. TATE REGAN, and COLONEL F. WALL as Honorary Foreign Members; the selection of Chicago as the 1939 meeting place; and the acceptance of Mr. Walter Necker's offer to prepare a twenty-five year herpetological index to COPEIA.

Sessions of July 20

THE opening session in the Life Sciences Building of the University of California was called to order by VICE-PRESIDENT KLAUBER at 9:45 A.M. Immediately following the address of welcome by DR. STORER the annual business meeting convened with fifty-five persons present, of whom 14 were Governors. By mutual consent the minutes of the previous meeting were dispensed with since these had been published in COPEIA.

The SECRETARY reported that 77 new members were secured in the period of 14 months since the previous meeting; 5 members died during the period, 18 resigned, 10 were dropped for non-payment of dues, 4 were transferred to the subscription file, and 4 were lost because of change in address. These changes resulted in a net gain of 36 members thereby increasing the total membership to 490. Twenty-eight new subscribers were added during the period, and 8 were discontinued, which resulted in a net gain of 20 subscribers and increased the subscription list to 117. The total number of members and subscribers was 607 on June 30, 1938. A geographical analysis of the members and subscribers indicated that 99 copies of COPEIA go to 26 foreign countries, with Canada leading with 31 copies, followed by Great Britain with 10. The domestic copies total 508 distributed in 43 states and the District of Columbia; 86 in New York, 62 in California, and 42 in Michigan, the three leading states. The Society has neither members nor subscribers in Delaware, Idaho, Montana, Nebraska, and South Dakota. The rolls include 6 fully paid Life Members and 10 partial Life Members who have made one or more payments of $25.00 each.

The SECRETARY summarized the report of the TREASURER for the calendar year 1937 as follows: actual cumulative debit balance on January 1, 1937—$256.59; total receipts for the year 1937, including contributions toward printing—$2,817.47; expenditures, including $1,912.42 for printing of COPEIA and reprints and $183.80 for photostating back numbers, totaled—$2,244.42. The actual credit balance on December 31, 1937, amounted to $300.06.

The 77 new members proposed during the year were formally elected. The Nominating Committee presented its report and the following officers were unanimously elected: JOHN T. NICHOLS and LEONARD STEJNEGER, *Honorary Presidents;* L. M. KLAUBER, *President;* A. W. HERRE, PERCY VIOSCA, JR., and HOWARD K. GLOYD, *Vice-Presidents;* M. GRAHAM NETTING, *Secretary;* ARTHUR W. HENN, *Treasurer;* HELEN T. GAIGE, *Editor-in-Chief* of COPEIA; LIONEL A. WALFORD, *Ichthyological Editor;* KARL P. SCHMIDT, *Herpetological Editor.*

The Business Meeting adjourned at 10:30 A.M., after which the following papers were read and discussed:

1. Additions to the Record of Amphibians in California—Tracy I. Storer.
2. Generic Delimitation of Myctophid Fishes—Rolf L. Bolin.
3. The Relation of Humidity to Herpetological Ecology in Mexico—Paul D. R. Rüthling.
4. The Occurrence of Newts in Southern China—J. Linsley Gressitt.
5. A Proposed Revision of Genera of Ophichthyid Eels near Callechelys; a new method of comparison—Margaret Storey.

The morning session terminated at 12:30, and following luncheon, reconvened at

2:10 P.M. with MAJOR GRANT, President of the Western Division, in the Chair. The following papers were read:

6. **Herpetological Collecting at Night on the Desert**—Laurence M. Klauber.
7. **The Genus Vaimosa: its Distribution and Ecological Position**—Albert W. Herre.
8. **An Ecological Study of Rattlesnakes on the San Joaquin Experimental Range**—Henry S. Fitch and Ben Glading.
9. **The Relation of the Ventral Lobes of the Hypophysis to the Anastomosis of the Internal Carotid Arteries in the Plagiostome Fishes**—H. W. Norris.
10. **Portraits of Amphibians and Reptiles of the Eastern United States**—M. Graham Netting.
11. **Notes on the Remarkable South American Cyprinodont Fish Tomeurus gracilis Eigenmann**—George S. Myers and Carl L. Hubbs.
12. **Northern Records of Rana cantabrigensis and Rana sylvatica with some measurements**—Clyde L. Patch (read by R. M. Anderson).
13. **Fishes of the Isolated Waters of the American West**—Carl L. Hubbs.
14. **Contributions to the Life Histories of Dicamptodon ensatus and Ambystoma gracile**—Wilbur V. Henry and Victor C. Twitty.

The afternoon session adjourned at 5:20 and the members reassembled at 7:15 P.M., in the Museum of Vertebrate Zoology for an Open House and Buffet Supper under the auspices of the Local Committees of the two Societies. The pleasure of this gathering was heightened by the opportunity to inspect an exhibit of living southwestern reptiles, together with maps of their distributions, assembled by L. M. KLAUBER.

Sessions of July 21

DR. BOLIN called the morning session to order at 9:10 for the reading of the following papers:

15. **Zoögeography of the Fresh-water Fishes of the Americas, with Particular Reference to the West Indies**—George S. Myers.
16. **Responses of Whip-tailed Lizards to Physiography in Western United States**—Thomas L. Rodgers.
17. **Certain Morphological Problems of Snake Locomotion**—Berry Campbell.
18. **Systematic Categories below the Rank of Species**—Rolf L. Bolin.
19. **Histology of the Skin of Some Lizards of Southern California**—Sarah R. Atsatt.
20. **Notes on the Behavior of Snakes Infected with a Blood Protozoan**—Sherwin F. Wood.
21. **Garter Snakes of the ordinoides Group**—Henry S. Fitch.

At 11:30 A.M. the members assembled for a group photograph. Following luncheon members visited the workrooms and exhibition galleries of the California Museum of Paleontology. At 3:45 P.M. a second Business Meeting was held with PRESIDENT KLAUBER presiding. DR. STORER, Chairman of the Resolutions Committee, submitted the following resolutions which were unanimously accepted:

I

The American Society of Ichthyologists and Herpetologists, convened in its Annual Meeting at Berkeley, California, on July 21, 1938, commends the issuance of wild life stamps by the American Wildlife Federation as an aid to the support of its activities.

The Society proffers the suggestion that future issues of such stamps include some illustrations of other forms of wildlife, particularly fishes, amphibians, and reptiles.

II

We, members of the Society, recognize the exacting demands involved in organizing and directing the Annual Meeting and we therefore extend a sincere vote of thanks to the Local Committee of Arrangements, and to the institutions that provided facilities, especially the University of California, Stanford University, and the California Academy of Sciences.

III

Whereas, the use and study of animals in captivity is necessary to many fields of scientific endeavor, and to the advancement of knowledge, especially in respect to human welfare and the welfare of domestic animals and of animal pets, and

Whereas, any restrictions on the holding and use of animals in captivity, beyond those dictated by humane treatment, is unnecessary, and

Whereas, many examinations of captive animals held for study by institutions and by private persons made by competent and unbiased lay observers have shown that such animals are not subjected to undue pain or discomfort in scientific laboratories,

Therefore, be it resolved, by the American Society of Ichthyologists and Herpetologists, that it disapproves of the enactment of legislation which seeks to impose prohibitive restrictions on the holding of animals in captivity by institutions, laboratories, or private persons, or on their use in observational or experimental studies.

IV

Whereas, the desert tortoise (*Gopherus agassizii*) which inhabits parts of the Colorado Desert and adjacent regions, occurs nowhere else on earth, and

Whereas, this unique and interesting animal is completely inoffensive and harmless in its habits, and

Whereas, an increasing traffic is developing in the sale of desert tortoises as souvenirs to tourists, and

Whereas, on account of the peculiar desert conditions required by the desert tortoise it seldom survives long in captivity elsewhere, and

Whereas, this animal is slow of propagation and, on account of said traffic, is noticeably decreasing in numbers and may be faced with extermination; *therefore, be it*

Resolved, that the American Society of Ichthyologists and Herpetologists, in annual meeting assembled at the University of California, Berkeley, July 22, 1938, does hereby recommend legal protection for the desert tortoise and urges that bills be introduced at the forthcoming session of the California legislature, designed to prohibit offering the desert tortoise for sale or receiving it for a consideration, *and be it further*

Resolved, that copies of this resolution be sent to the California Division of Fish and Game and the California State Park Commission.

V

The flourishing condition of our Society, as shown in the Annual Reports of the Secretary and Treasurer, gives abundant testimony that the Officers have labored long and well in the discharge of their duties, and

The sustained high quality of our journal, COPEIA, reflects continued diligence and acumen by our Editorial Board;

Therefor, be it resolved, that we, the members present at the 1938 Meeting, hereby express our sincere appreciation of the efforts of the Officers of the Society for their services.

Following a short business meeting of the Western Division the members joined with the American Society of Mammalogists in viewing excellent motion pictures of the 1938 Allan Hancock Expedition presented by GEORGE S. MYERS and GEORGE S. GARTH; a reel showing the feeding of rattlesnakes, prepared and presented by CHARLES T. VORHIES; and a final reel devoted to the California sea otter.

At 7 P.M. the members assembled for a joint Annual Dinner of the two Societies at the Berkeley Women's City Club. Under the able direction of Toastmaster ABBOTT interesting talks were given by DR. GRINNELL, by the newly elected President of each Society, and by other guests.

Sessions of July 22

THE morning session was called to order in Jordan Hall at Stanford University for the reading of the following papers:

22. **Notes on the Taxonomic Status and Ecology of Salmo nelsoni in Lower California**—Osgood R. Smith.
23. **Notes on the Introduction of Mexican Trout**—Paul R. Needham.
24. **The American Species of Clupeid Genus Harengula: Certain Useful Generic and Specific Characters**—Margaret Storey.
25. **Systematic and Experimental Studies on California Triturus**—Victor C. Twitty.
26. **The Black Toad of Deep Springs Valley, Inyo County, California**—George S. Myers.

Following the luncheon the members visited the Stanford Natural History Museum to examine the ichthyological and herpetological collections and to view several exhibitions of drawings and living specimens. The evening program consisted of a series of motion pictures in natural color of California Wild Animals presented through the courtesy of the California Division of Fish and Game.

Sessions of July 23

THE morning was devoted to a trip to the Museum of the California Academy of Sciences and to the Steinhart Aquarium in Golden Gate Park. The authorities of the Academy enabled the members to visit the magnificent Simpson African Hall as well as the famous scientific collections of the Academy.

The total signed registration at the meeting numbered only 75, but the average attendance at sessions (over 60) was higher than at any previous meeting of this Society. The LOCAL COMMITTEE is to be commended especially upon the excellent program of entertainment provided for the wives of delegates. All members in attendance were agreed upon the success of the meeting. Once again the Secretary deplores the self-imposed anonymity of the Local Committee, each member of which worked diligently both prior to and during the meeting.——M. GRAHAM NETTING, *Secretary.*

Meeting of the Pacific Division

LOCAL members of the Society arranged several interesting events during the recent meetings of the Pacific Division of the A.A.A.S. at San Diego. On June 24 more than 20 members and guests attended an informal gathering at the home and laboratory of L. M. KLAUBER, where his unsurpassed collection of southwestern rattlesnakes and other herpetological specimens were on display. Among those present were DR. and MRS. T. I. STORER, C. B. PERKINS, RICHARD DORN, L. M. HUEY, L. H. COOK, A. P. ARTRAN, F. F. GANDER, H. DAVID MICKENER, JACK MURRAY, CHARLES SHAW, MAJOR CHAPMAN GRANT, DR. SARAH R. ATSATT, MARGARET STOREY, ROSA EIGENMANN, THORA EIGENMANN, EDNA CANEY, and AMY RHINEHARDT.

On June 25, a night desert collecting trip yielded the following reptiles: 10 *Coleonyx variegatus,* 1 *Uta graciosa,* 14 *Phyllorhynchus decurtatus perkinsi,* 4 *Arizona elegans occidentalis,* 1 *Hypsiglena ochrorhynchus,* 1 *Masticophis flagellum frenatus,* 1 *Lichanura roseofusca roseofusca,* 1 *Sonora occipitalis,* and 1 *Crotalus cerastes.* Each of the two autos covered about 50 miles in desert territory between 7 and 11 P.M., mostly in the vicinity of The Narrows. The specimens were spotted from the cars in the road and on the shoulders. Air temperatures varied from 86 to 91° F. In addition to the 11 lizards and 23 snakes collected, 14 snakes, representing 10 different species, and 2 lizards were

observed dead on the road. Some of these were in good enough condition to be saved.

Because of the national meetings of the Society at Berkeley, July 20–23, the Western Division did not participate in the meetings of the Pacific Division of the A. A. A. S. this year.—MARGARET STOREY, *Museum of Natural History, Stanford University, California.*

News Items

DR. STILLMAN WRIGHT, of the U. S. Bureau of Fisheries, reports the opening of the Intermountain Office of the Division of Scientific Inquiry at the Utah Agricultural College at Logan. This location will have the advantage of bringing the fish work of the region into close union with the game management work now being conducted in Utah under the present coöperative arrangement between the Biological Survey, State Agricultural College and State Fish and Game Commission.

ARTHUR L. CLARK, formerly of the Connecticut Fish and Game Department, has been appointed as head of the newly established Section of Fish, Game and Forestry of the Missouri State Conservation Commission.

DR. HOBART SMITH has been awarded the Walter Rathbone Bacon scholarship of the Smithsonian Institution. Dr. Smith will leave in September for Mexico, where he will spend two years in studying the herpetological fauna.

DR. CHARLES WALKER has joined the permanent staff of the Franz Theodore Stone Laboratory on Gibralter Island, Lake Erie, where he will teach ornithology and herpetology.

LESTER SMITH, commercial fisherman of Port Washington, Wisconsin, noted for his active interest in fisheries research, his tagging experiments, and the papers he contributed to the American Fisheries Society meetings, died in April.

ERNEST G. MARSH, JR., operating under a fellowship of the University of Texas, is conducting a biological survey of Coahuila, Mexico, and is making collections of fishes, amphibians and reptiles.

DR. GEORGE S. MYERS, Associate Professor of Biology in Stanford University, and Head Curator of Zoological Collections in the Stanford Natural History Museum, has been appointed to a full professorship beginning with the coming academic year. Dr. Myers has recently returned from the Sixth Allan Hancock Pacific Expedition with large collections of marine fishes from the Galapagos Islands, Peru, Ecuador and Colombia.

Announcement is made of the forthcoming publication of a new journal, the STANFORD ICHTHYOLOGICAL BULLETIN, the first number of which will be issued this spring. The Bulletin will be published by the Natural History Museum of Stanford University, and will be devoted to papers on all phases of ichthyology, including fisheries biology, originating in, or connected with Stanford University. The new journal will be edited by DR. GEORGE S. MYERS, to whom inquiries should be addressed.

DR. CLARENCE M. TARZWELL has joined the fishery research staff of the T.V.A., with headquarters at Decatur.

DR. RICHARD WEISSENBERG, one of Adolph Hitler's guest scientists in America, has been appointed a fellow of the Wistar Institute of Anatomy and Biology in Philadelphia. He is working at the laboratory of the biological farm of the Wistar Institute, and hopes to continue there the researches he has been conducting at Washington University, St. Louis, on the Lymphocystis disease of fishes.

A conference of all those studying the PACIFIC SARDINE was held at the Stanford University laboratories of the United States Bureau of Fisheries on May 9–11. Representatives of the fishery departments of British Columbia, Oregon, Washington, California and of the United States Bureau of Fisheries attended. The principal topics of discussion were the Independence or Interdependence of Pilchard Populations Along the Pacific Coast, The Life History of the Pilchard, and Fluctuations in Abundance.

THE AMERICAN FISHERIES SOCIETY and the INTERNATIONAL ASSOCIATION OF FISH, GAME AND CONSERVATION COMMISSIONERS met jointly at Asheville, North Carolina, during the week of June 19.

Correction

IN COPEIA, No. 2, 1938, in the article "The Jamaican *Dromicus funereus* (Cope) Re-established" by Chapman Grant, read *Dromicus* for *Leimadophis* throughout, except for references in synonymy.

COPEIA IS THE JOURNAL OF THE AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS

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Figures, author's corrections, expensive tabular matter and unusually long articles may be charged in whole or in part to the author, at the discretion of the Editors.

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